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FIRST ANNUAL REPORT

OF THE

STATE

AGRICULTURAL EXPERIMENT STATION,

AT

AMHERST, MASS.

1883.

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MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

AT AMHERST, MASS.

BOARD OF CONTROL, 1883.

HIS EXCELLENCY B. F. BUTLER,

Governor of the Commonwealth, President ex officio.

J. P. LYNDE, ... Athol.
JAMES R. NICHOLS, ... Haverhill.

Members of the State Board of Agriculture.

O. B. HADWEN, ... Worcester,
J. H. DEMOND, ... Northampton.

Members of the Board of Trustees of the Mass. Agricultural College.

THEODORE LYMAN, ... Brookline,

Member of the Massachusetts Society for Promoting Agriculture.

JAMES C. GREENOUGH, ... Amherst.

President of the Massachusetts Agricultural College.

OFFICERS APPOINTED BY THE BOARD OF CONTROL.

C. A. GOESSMANN, Prof. of Chemistry at the Mass. Agricultural College.

Director and Chemist.

M. MILES, Prof. of Agriculture at the Mass. Agricultural College.

Supt. of Field and Stock Experiments.

S. T. MAYNARD, Prof. of Botany at the Mass. Agricultural College.

Supt. of Horticultural Experiments, Microscopist and Draughtsman.

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To the Secretary of the State Board of Agriculture.

SIR: — I herewith transmit to you for the approval of the Board and publication in your report to the Senate and House of Representatives the reports made by the officers of the Agricultural Experiment Station to the Board of Control.

O. B. HADWEN,
Secretary.

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ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN:—I have the honor to present herewith respectfully the Annual Reports.

The real estate rented from the trustees of the Massachusetts Agricultural College consists of one dwelling house for offices and collection rooms, one barn with stables for stock-feeding experiments, and nineteen acres of land for field experiments. A few rooms set apart in the chemical department of the college serve as a laboratory for the execution of the chemical work of the station. The reconstruction of the buildings accepted by the Board has been devised and conducted by the committee appointed for that purpose; namely, the President of the college and Mr. Hadwen. The refitting of the barn and stables for stock-feeding experiments has been under the personal supervision of Professor M. Miles, and in the main according to plans of his submitted for consideration to the committee on buildings. A detailed description of this work, with illustrations, will be found in his report to the Secretary of the Board. The supervision of the field work has been divided between Prof. Miles and Prof. Maynard. To the former has been assigned sixteen acres in the vicinity of the farm buildings of the station; to the latter three acres near the plant-house in the botanical department of the college.

The field work of the station during its first year of active operations has been in several directions, and for obvious reasons of a preparatory character.

As the lands secured from the college consisted largely of grass land, of some pieces of winter grain — wheat — and

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the experimental plats of the former for studying the growth of a variety of fruit and forage plants, it seemed for economical reasons best to secure the crops for the payment of the rents, and to prepare additional plats for field experiments, with reference to the limited financial resources at the disposal of the Board. Two and two-tenths acres of corn — in part for ensilage — and about one and one-half acres of a series of prominent forage crops, leguminous plants in particular, for comparative analysis regarding their relative feeding value, comprise the produce of the newly-arranged plats. A description of eleven underdrained plats, with an illustration of the entire work of underdraining, and of grading in a certain section of the farm land, and near the buildings designed for experimental work, will be found in the above stated report of Prof. Miles.

The same report contains the details of the cultivation of the corn, and of the filling of the silo, and of a feeding experiment with pigs, accompanied by the views of Prof. Miles regarding these matters.

The experiments concerning the effect of special mineral manures on the growth of fruit-bearing plants, and the character of the fruits produced by their assistance, which were inaugurated about ten years ago, have been continued for the past year. Two additional experimental plats of land were secured for the cultivation of fruit-trees, with the aid of the muriate of potash and the sulphate of potash, for the purpose of ascertaining their respective effect, in the interest of economy.

The cultivation of forage crops has received considerable attention, new varieties having been added to those cultivated in previous years. Collections at different stages of growth have been made, to ascertain their respective nutritive value. A description of the field work in connection with these experiments will be found in the appended report of Prof. S. T. Maynard, in whose particular care the lands occupied by small fruits, fruit trees and forage crops above referred to, have been during past years. Prof. Maynard's report contains also his experiments regarding the destruction of injurious insects and of fungi growth. His examination regarding the adulteration of field and garden seeds,

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besides his inquiries concerning the best means for the destruction of the seeds of weeds, is fairly under way, and reports of the progress in these matters may soon be expected in the periodical publications of the Station.

The investigations concerning the characteristics of the "*fire worm*," the pest of the cranberry, with a view of ascertaining the means for its destruction, which, by a vote of the State Board of Agriculture, had been referred to the Station, has received a careful and generous attention, at my invitation, by Prof. W. S. Stearns, an entomologist by profession. The results of his work have been presented, in an able paper, at the late country meeting of the State Board of Agriculture, at Lowell.

The chemical department has been engaged to the full extent of its means. Most of its work has been already published in six monthly bulletins.

The analytical examinations comprise a series of articles sent on for that purpose by farmers' clubs; leading agricultural chemicals and other commercial manurial substances, not under control of the fertilizer laws; a variety of refuse material for the manufacture of home-made fertilizers; important commercial fodder substances, and leading farm crops.

The details of these investigations form the principal portion of the report of the chemist. This report contains also some statements regarding previous examinations, which have not been published in full in any State report, and, judging from frequent inquiries received, will prove of interest to some of the friends of progressive agriculture.

It has been the aim, in the management of the work of the Station, to meet promptly the direct applications of farmers' clubs, and the temporary wants of the farming community, and to prepare, as fast as circumstances enabled, and the thoroughness of the future work admitted, for experiments in field and barn.

Much work has been accomplished in both directions. Analyses of the drainage waters of the underdrained experimental plats, and of the crops raised upon the latter, as well as those raised on the remaining fields of the station, have been made, to serve as a basis for field and feeding experi-

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ments during the coming season. The stables for feeding experiments are finished on a general plan, and require but limited expense and time to be fitted for special experiments in stock-feeding.

A considerable amount and variety of fodder raised upon the fields of the Station is on hand, to serve, in connection with the silo product, for feeding experiments.

Want of time and of means have thus far prevented the entering upon a systematic observation of the weather and the relation of the atmosphere on the physical and chemical condition of the soil. The observations which have been made in this direction are consequently rather fragmentary, and will be retained for the present, to be published when properly supplemented. One of the principal wants in the present stage of the Experiment Station consists in suitable rooms fit for careful observations of various kinds in agricultural chemistry and physics. The space at present occupied by the chemist consists of two rooms for general analytical work, for which they are well adapted. The remainder of the building, known by the name of "Chapel building," is occupied for various purposes by the college, and is decidedly inadequate to its daily-increasing wants. No more room can be obtained from the college authorities, nor can the restoration of the two rooms occupied by the Station meet the wants of the college. As the gas works of the Experiment Station are in connection with its present laboratory, and the building very suitable for the immediate wants of the experiments, as far as additional buildings are concerned, it seems, in the interest of economy, advisable to induce the college authorities to assign the entire building to the use of the Station, at a liberal rent; and to meet their wants by the erection of a new building, which they will be obliged to do at an early date. The best interests of both State institutions will be benefited by such an arrangement, which is presented for your careful consideration.

C. A. GOESSMANN,
Director.

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REPORT OF SUPERINTENDENT

OF

FIELD AND FEEDING EXPERIMENTS.

To the Honorable the Board of Control of
The State Agricultural Experiment Station.

The following report of operations in the department of Field and Feeding Experiments for the year 1883 is respectfully submitted.

M. MILES,
Superintendent of Field and Feeding Experiments.

At the beginning of the present year an outline of a plan of experiments, in this department, was drawn up by me for the consideration of the Board, together with a plan for the required alterations in the old barn to fit it for the purposes of feeding experiments, and presented to Director Goessmann.

Having been informed that this plan of proposed experiments had been approved by the Board of Control, I was instructed by the Director of the Station to locate and stake out the proposed plats for the field experiments, and to construct the required drains, with provisions for collecting the drainage waters, to carry out the systematic investigations contemplated in the outline presented under the first subdivision of the approved plan.

The Field Plats.

After a careful examination of the area assigned for field experiments and a detailed study of its previous history as to cropping, with reference to its present agricultural condition, — in which I was materially aided by the advice and suggestions that were kindly given by Hon. Levi Stockbridge,

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ex-president of the Agricultural College, — two series of plats were selected that presented the required conditions of uniformity and surface soil and exposure.

When the trenches for laying the tiles had been dug, it was likewise found that the subsoil in each series of plats was quite as uniform in its characteristics as the surface soil.

Through the liberality of Mr. W. W. Hunt of Amherst, who volunteered to furnish the tiles at actual cost, the Station had the benefit in their purchase of strictly wholesale rates.

The arrangement of the plats and the location of the drains will be readily understood by reference to the plan, in the supplementary paper, marked "Exhibit B."

The plats are two rods wide and eight rods long, giving an area of one-tenth of an acre each. To prevent any confusion as to locality, when referring to a particular plat, the east series of plats are designated by odd numbers, and the west series by even numbers.

The dotted line on the plan marks the boundary of an area that was cultivated as a vegetable garden for several years. From the heavy applications of manure that had formerly been made to this garden patch, the west series of plats should only be used for rotation experiments, which should be made to ascertain the influence of one crop upon the growth of another, and the influence of the system of cropping in conserving the elements of fertility, and upon the loss of fertilizing materials by drainage.

The east tier of plats (with odd numbers) have been under ordinary field culture, and for several years past in grass, which is badly "run out," the hay having been removed without the return of an equivalent in the form of manure; so that their present condition, as represented by their past history, is well adapted to the proposed permanent experiments with corn.

Drains.

A main drain of round tiles laid four feet deep has been made along the east side of each series of plats (four feet from the line of plats), with wells of sewer pipe opposite the middle of each plat, for the purpose of collecting samples of the drainage waters from the lateral drains which open

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into them. The size of the tiles in the main drain is marked in red ink on the plan.

The laterals, of two-inch round tiles, are laid through the middle of each plat, and have their outlet in the wells twelve inches above the grade of the main drain.

From the great practical, as well as theoretical, importance of the experiments with drainage waters, extraordinary care has been taken in laying all of the tiles in the system of drainage, the slope or fall being the same in all cases to secure uniformity in their action, and to prevent the formation of pools of stagnant water within the range of the tiles to modify the composition of the drainage waters when the drains are running.

Culvert.

To secure an outlet for the main drain it was necessary to make a deep cut across the roadway on the south line of the experimental field, and make a new culvert to provide for the surface-drainage in the spring. This culvert is made of six-inch sewer pipe, resting on a wall of stones laid in cement to a depth of four feet below the line of pipes, to prevent the displacement of the sewer pipe by frost. A similar culvert was also made across the roadway on the north line of the experimental field.

In the construction of the main drains many large boulders were encountered in the lower twelve inches of the trench, which, together with the compactness of the clay and imbedded gravel, materially increased the cost of the work.

The work of digging trenches for the tile drains was begun April 16th, and the laterals on the east tier of plats were completed May 10th. From a delay in obtaining sewer pipe, the wells were not finished until some time afterwards.

Corn Experiments.

An account of the experimental crop of corn grown on the east series of plats, together with observations made on the drainage waters, will be found in the paper marked B, accompanying this report.

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Drainage of Buildings.

After every heavy rain in the spring the floor of the box stalls, the scale pit in the barn, and the cellar of the house, were flooded with water — the soil in the vicinity of the buildings being completely saturated, almost to the surface.

On the 6th of May I presented to Director Goessmann a report of expenditures made by me in the work under my charge, together with estimates and recommendations in regard to the drainage of the buildings.

The construction of this system of drains having been authorized by the Board of Control, the work was begun by securing an outlet, by a junction with the main drain of the experimental plats, where it crosses the road on the south line of the experimental farm.

As a matter of economy, I can only repeat the recommendation made in the report of May 6th: that a six-inch tile should be laid from the culvert, where the present main has its outlet, to the small stream running across the farm, in order to secure a permanent outlet for the system of drains on the experiment farm.

In laying the main for the drainage of the buildings the same difficulties were encountered as in the case of the mains of the experiment plats, with the additional disadvantage of running water in the trenches, notwithstanding the work was done later in the season. A plan of these drains, showing their relation to the buildings, is given on the following page: —

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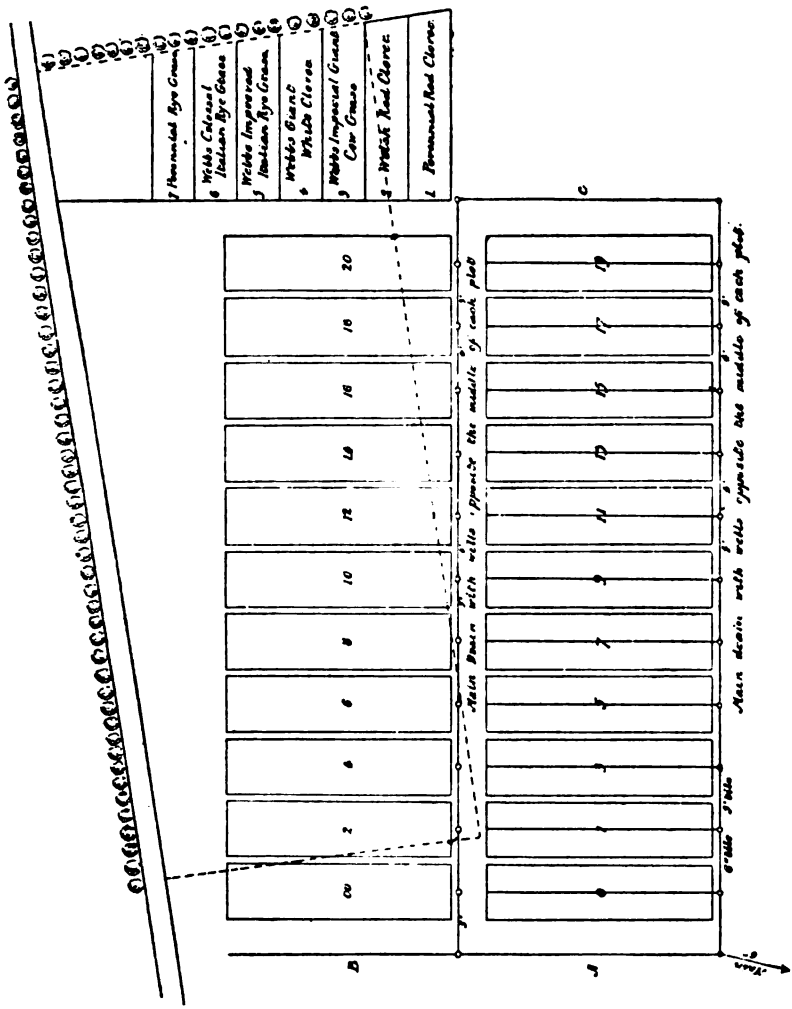

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Forage Crops.

With the approval of Director Goessmann, I ordered from England some seeds of forage crops, that seemed to be worthy of trial, which have been sowed on a series of plats just north of the plats heretofore described. From delays in transportation and detention in the custom house, the seeds were not sown until June 6th, the beginning of the dry season. Notwithstanding the unfavorable conditions of growth, the plants appear to be fairly well rooted, and the results for next summer will be looked for with interest. The varieties of seeds sown are marked on the plan of plats given in the report on corn experiments, marked "Exhibit B," as follows: —

1. Perennial Red Clover.
2. Welsh Red Clover, claimed to be "well adapted to land at all clover-sick."
3. Imperial Giant Cow Grass.
4. Giant Perennial White Clover.
5. Webb's Improved Italian Rye Grass.
6. Webb's Colossal Italian Rye Grass.
7. Perennial Rye Grass.

Feeding Barn.

The feeding barn was repaired and reconstructed, under my personal supervision, in accordance with the plan approved by the Board of Control, and under the advice and direction, from time to time, of Mr. O. B. Hadwen and Director Goessmann of the Building Committee. It is arranged with six box-stalls with cement floors, for feeding cattle and valuing manure, and twenty pens for feeding pigs and other small animals. There is also a silo, an engine-room, and feed-rooms, with convenient fittings for experiments.

The ground floor of the barn is given in outline on the following plan: —

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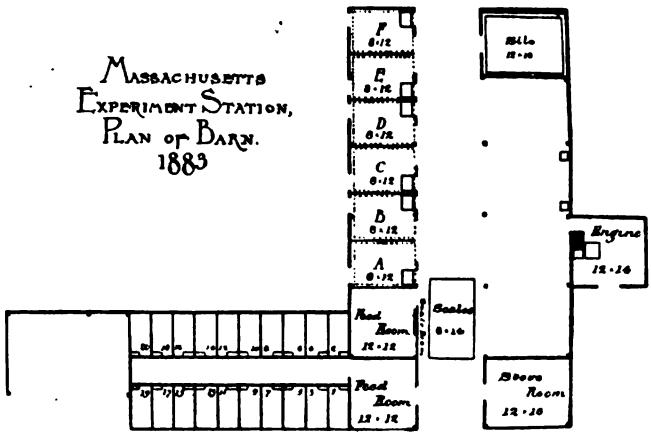

The scales, manufactured to order with both metric and United States standard weights, were furnished by Fairbanks, Brown & Co. of Boston, at a very liberal discount from current rates.

Experiments.

When the barn was completed I was officially notified that the feeding experiments would be confined to the feeding of ensilage, and I was directed to superintend the construction of a silo to prepare for that work.

A description of the silo and the progress that has been made in the experiments with ensilage will be found in detail in the paper presented herewith, marked "Exhibit E."

The results thus far obtained are of great practical interest, as they seem to indicate the conditions that must be observed in preserving green crops in the form of ensilage, in order to secure a reasonable certainty in the results and a desirable uniformity in the quality of the product.

My opportunities for experimental work have been exceedingly limited, from the fact that most of my time has been spent in the personal supervision of the improvements in progress in the experiment field and in and around the buildings, as in the laying out of plats, the construction of drains, grading of the grounds, and making drive ways, etc., etc.

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With the aid of my assistant, the work of making feed-bins, racks for drying experimental crops, fittings for pens and boxes, and other appliances for the purpose of experimentation, has been done in the intervals of other duties.

Hay.

The hay of the experimental farm was turned over to the college farm by Director Goessmann, with the exception of the produce of certain areas, which I was requested to select for experiments in feeding, which is stored in the feeding-barn on the upper floor

Grounds.

The grounds around the building have been graded and seeded with a mixture of lawn grasses, and the road-bed of the carriage way in front of the buildings has been filled with stones and partly covered with gravel.

Pig Feeding.

Permission having been given me to "make any experiments that did not involve expense to the station," ten Berkshire pigs were placed in the pens October 18 and fed until December 17. The details and result of this experiment are herewith presented in the paper marked "Exhibit F."

In the supplementary papers presented with this report approximate estimates have been made of the additional facilities that are required in this department to carry on the work in a satisfactory manner.

Massachusetts Experiment Station,
Department of Field and Feeding Experiments,
Amherst, Dec. 22, 1883.

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[EXHIBIT B.]

CORN EXPERIMENTS AND DRAINAGE.

EXPERIMENTS WITH INDIAN CORN.

In accordance with the plan of experiments, approved by the Board of Control in January, corn was grown on the east series of plats (designated on the plan by odd numbers), without manure, and under the same conditions as to management, for the purpose of testing the relative fertility of the plats.

The arrangement of the plats and an outline of the drains are given on the accompanying plan. The plats, of one-tenth of an acre each, are two rods wide and eight rods long, and they are separated by a space four feet wide, on which no crop is grown.

The soil is a friable loam, with a retentive subsoil of clay that is nearly filled with gravel and small stones in the lower strata.

There is a remarkable uniformity in the soil and subsoil of the different plats, both as to apparent fertility and physical condition, with the exception of plat 0, where a large manure pile had formerly been made.

When the plats were laid out, it was readily seen, from the luxuriant growth of grass on plat 0, that it would not be comparable with the other plats under any conditions, but it was finally staked out, and added to the series as an extra plat, as it furnished the opportunity for studying the drainage waters of a soil highly manured.

In all operations of ploughing, cultivating, planting, hoeing and harvesting, the work was done lengthwise of the field, and consequently across the plats, so that each plat received the same treatment, as far as possible, both as to the amount of labor expended and the time in which it was performed.

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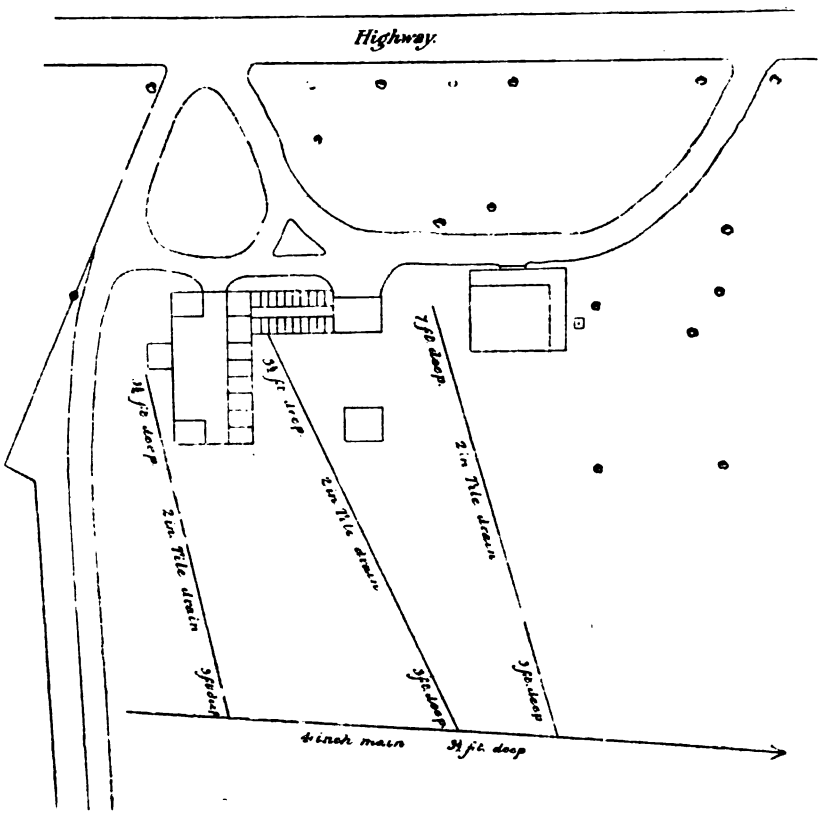

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The plats were ploughed May 14, but from the heavy rains that soon followed, which are noticed in the account of the drainage, the after-cultivation was delayed until May 25, and the corn was not planted until a week later.

"Longfellow corn" was planted June 2, in hills, forty-four inches apart each way. The soil was in fine condition, and the plants came up evenly on the 8th inst., looking healthy and vigorous.

As the first and second days of June were the first really warm days of the season, the late planting did not at the time seem to be a serious disadvantage.

The cultivation of the crops was as follows: Cultivated, June 15; hand hoed, June 18; thinned to four plants in a hill, June 21; cultivated and hoed, without hilling, June 26, July 9 and 25; and a final hoeing, which was limited to killing the weeds that had survived the previous treatment, was given August 2.

The plats were quite free from weeds on the start, and the repeated cultivation and hoeing left the crop perfectly clean in its subsequent growth.

On the night of September 3 a hard frost severely injured the corn, and it should have been cut up the following day; but as we were dependent on the farm for labor, we were obliged to wait until the 7th inst., when the crop was cut close to the ground and put in stooks to cure. The leaves were considerably "wilted," but the stooks were not apparently injured.

The corn was husked October 18 by the "juniors," who volunteered their services, so that all the plats could be husked in one day. The corn and stalks were hauled to the barn and separately weighed, but the corn from plats fifteen, seventeen and nineteen was not weighed until the next morning. In Table I. the weight of corn and stalks is given for each plat: —

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TABLE I.

PLATS.	No. of missing hills.	Sound Corn, lbs.	Soft Corn. Lbs.	Total Corn.	Stalks. Lbs.
0, ...	0	224.5	101.5	326.	578
1, ...	3	90.5	142.25	232.75	445
3, ...	2	91.5	136.	227.5	410
5, ...	2	103.	138.5	241.5	437.5
7, ...	4	98.5	123.	221.5	400.
9, ...	7	119.5	98.	217.5	383.
11, ...	5	115.5	104.	219 5	390
13, ...	5	88.	109.	197.	356
15, ...	3	46.5	127.5	174.	340
17, ...	6	52 75	138.75	191.5	355
19, ...	4	76.	143.	219.	400

It should be noted that from an error in making and planting, made by the unskilled hands assigned me, it became necessary to transplant several rows of corn on plats 13, 15 and 17, and that although the greatest care was taken in the work, the transplanted hills were checked in their growth and never fully matured. This will, in part at least, account for the lower yield of both stalks and corn on these plats.

The corn from plats 0, 1, 3, 5, 7, 13 and 19, was put in thin bags and placed on racks suspended by wires over the barn floor for further drying; and the stalks from plats 0, 1, 3, 5 and 7 were likewise separately stored, so that they could be again weighed.

These reserved samples were re-weighed November 17, with the results given in Table II. The loss in drying, per acre, is given in *italic*.

Both stalks and corn are still preserved for weighing at intervals during the winter and spring:—

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TABLE II.

PLATS.	Sound Corn, lbs.	Soft Corn. lbs.	Total Corn. lbs.	Stalks. lbs.
0,	207.5 *170.0*	88.5 *130 0*	296.0 *300.0*	447.5 *1305.0*
1,	83.0 *75.0*	122.5 *197.5*	205.5 *272.5*	345.0 *1000.0*
3,	83.0 *85.0*	115.0 *210.0*	198.0 *295.0*	320.0 *900.0*
5,	94.75 *82.5*	119.0 *195.0*	213.75 *277.5*	345.0 *925.0*
7,	85.0 *135.0*	101.25 *217.5*	186.25 *352.5*	315.0 *950 0*
13	79.5 *85.0*	91.25 *177.5*	170.75 *262.5*	
19,	67.25 *87.5*	123.5 *195.0*	190.75 *282.5*	

DRAINAGE WATERS FROM EXPERIMENTAL CORN PLATS.

As an introduction to this subdivision of my report, it may be well to make a condensed statement of some of the results of the latest researches in regard to the relations of the soil to the supplies of plant food which have prompted me to give such prominence to the investigation of drainage waters in the "Plan of Experiments," drawn up for the consideration of the Board of Control.

It has long been known that nitrogen, in some form, was essential in the processes of plant-growth, but its immediate source and the form in which it could be appropriated were matters of conjecture only, while the abundance of free nitrogen in the atmosphere furnished the basis of hypotheses that have not stood the test of experimental investigations.

The researches of Boussingault, in connection with the later and more exhaustive experiments of Lawes and Gilbert

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and Righ at Rothamstead, seem to show conclusively that the free nitrogen of the atmosphere is not the direct source of the nitrogen of plants.

From later investigations it appears to be settled that most of our farm crops, and particularly the cereals, take up nitrogen only in the form of nitric acid; but it is perhaps probable that leguminous plants, and possibly Indian corn, may make use of nitrogen in organic combination, which is not available for other plants.

According to the latest report (1883) on the rainfall at Rothamstead, the total amount of combined nitrogen in the average annual rainfall, of twenty-nine inches, is estimated by Lawes and Gilbert and Warrington at 4.5 lbs. per acre, and they say, "As to the amount of gain by absorption by the soil, there is unfortunately no direct or satisfactory evidence at command. From such evidence as does exist, we are disposed to conclude that with some soils the amount will probably be greater, and with others less than that supplied by the rainfall."

It will not, therefore, be safe to estimate the atmospheric supplies of nitrogen at more than 10 lbs. per acre, annually, and this must be obtained through the medium of the soil, the direct absorption of the ammonia of the air, by plants, being so slight that practically it need not be noted.

As our farm crops contain on the average from twenty-five to considerably more than one hundred pounds of nitrogen per acre, we must look to the soil and to the manures applied as the principal source of available nitrogen.

A large part of the nitrogen of the soil is in organic combination, but nitrogen in this form, as well as that in nitrogenous organic substances and ammonia salts that are applied as manure, must be transformed into nitric acid before it is available for plant growth.

But little has been known in regard to this process of nitrification until within a few years past, notwithstanding the theories that have been formed to account for it.

From the experiments of Schloessing and Muntz, which were first published in 1877, it is evident that the nitrification of soils is caused by a living organism, which acts as a

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ferment, and they afterwards, by a system of cultivations, isolated and identified the specific form as a member of the family of bacteria.

The experiments on nitrification made by Warington at Rothamstead in 1877, 1878, and 1879, have fully substantiated the claims of the French chemists, and furnished additional information of practical value in regard to the *rôle* of the bacterium that performs such an important part in the process of vegetable nutrition.

These bacteria abound in every fertile soil, and as a function of their vital activity are constantly transforming the nitrogen of organic substances and of ammonia, in the surface soil, into nitric acid, when the proper conditions of moisture and temperature are present.

The bacteria of nitrification are most active at a temperature of about 99° F. — they act slowly when the temperature is lowered to near the freezing point, or when it is raised to 122° F., and at 131° F. their peculiar function as a ferment ceases.

Another important condition is essential to rapid nitrification, namely, the presence of an excess of some salifiable base, as carbonate of calcium, so that nitrates can be readily formed. This accounts for the action of lime when applied to peaty soils, which has not heretofore been satisfactorily explained.

The nitrates, as found, may be at once taken up by the roots of living plants, or, in their absence, they will be washed by the rains to the lower strata of the soil beyond the reach of shallow-rooted plants, or they may be lost entirely in the drainage waters.

It must therefore be seen that the nitrification of soils, and the conservation of the nitrogen in the form of nitrates are biological processes involving the activities of living organisms.

During the summer the process of nitrification is carried on rapidly, and the nitrates are taken up by the growing crops; but after harvest, on cropped land — and where land is fallowed — the nitrates accumulate in the surface soil until the fall rains wash them down to the lower strata.

A few examples from the experiments at Rothamstead will sufficiently illustrate the behavior of the nitrates in the soil.

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The soil of the drain-gauges at Rothamstead (of $\frac{1}{1000}$ of an acre in area), is unmanured and uncropped, representing in fact the conditions of a bare fallow. The loss of nitrogen in the drainage waters of the gauge, sixty inches deep, amounted to 42.64 pounds per acre annually on the average for five years. This loss was distributed as follows: —

For the three months January–March, . .	9.92	pounds per acre.
For the three months April–June, . . .	6.10	pounds per acre.
For the three months July–September, . .	10.80	pounds per acre.
For the three months October–December, .	15.82	pounds per acre.
Total, ...	42.64	pounds per acre.

On land cropped continuously with wheat, the loss of nitrogen in the drainage waters was estimated as follows: On plats that received no nitrogenous manures, the average loss for two seasons of excessive drainage was from 15 to 17 pounds of nitrogen per acre, while the average for thirty years was from ten to twelve pounds per acre.

Where from 43 to 129 pounds of nitrogen was applied in the form of ammonia salts, the loss of nitrogen by drainage was estimated at from 19 to 42.4 pounds per acre annually.

These experiments with drainage waters have been supplemented by an extended and systematic examination of the soils.

In the Hoos field, which has been alternately in wheat and fallow since 1851 without manure, samples of the soil were taken in September, 1878, with the following results: —

DEPTH.	Nitrogen as Nitrates in Lbs. per Acre.	
	From half of the field in wheat.	From half of the field in fallow.
First 9 inches, ...	2.6	28.5
Second 9 inches, ...	Trace.	5.2
Total in 18 inches, ...	2.6 lbs.	33.7 lbs.

The wheat had evidently taken up the nitrates as they had been formed, and losses of nitrogen by drainage would not be likely to take place until after harvest. "In three soils

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at Rothamstead, in fair agricultural condition, cultivated as bare fallows since the harvest of the previous year, 56.5, 58.8 and 59.9 pounds of nitrogen, as nitric acid, per acre, were found in September or October to the depth of 27 inches. If the summer has been dry, the nitrates are near the surface; after much rain they are at a lower level.

Without further discussion of these valuable and interesting experiments, it will be clearly seen that the work of experimentation in this field of research can no longer be retarded by the vague and indefinite problems presented by former crude theories. From our present knowledge of the process of nitrification, and of the relations of the elements of fertility to the soil under different conditions, all of which is largely owing to the remarkable series of experiments conducted at Rothamstead for the past forty years, the lines of investigation that give promise of immediately practical results are well defined and can be readily followed.

Experiments are now needed to determine the applicability of the results obtained at Rothamstead to the different climatic conditions that prevail in this country. That the general relations of the plant-food to the soil are the same cannot be doubted; but we need information as to the modifying influences of the varied conditions.

Drainage Waters of the Experimental Corn Plats.

In the selection and arrangement of the experimental corn plats, as well as in the construction of the drains, particular care has been taken to secure uniformity in all conditions that could possibly have an influence on the composition of the drainage waters.

When the work of digging the trenches for the tiles was begun, April 16, the soil was saturated with water within about twelve inches of the surface.

The water table was of course lowered as the drains were laid, and for some time before the last laterals were finished, May 10, the two-inch drains had stopped running, and there was but little water even in the main drains. A heavy rain fell on the night of May 21, and continued through the following day.

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The drains on plats 3 and 13 and the "headers" B and C, were running at 10 A.M. on the 22d inst., and at 11 A.M. all the drains were running with the exception of the one on plat 19.

Samples of the drainage waters, for analysis, were taken from plats 0, 3, 13, and from the "header" C. That from plat 0 was not clear.

At 1.30 P.M. all the drains were running, and the water was clear, with the exception of that from plat 7, which was slightly turbid. The drains from plats 15, 17 and 19 discharged less than the others.

At 2.30 P.M. samples of the drainage waters were taken for analysis from all the plats and from the headers B and C. At 5 P.M. the header C was running full, the drains on plats 0, 1 and 3 nearly full, and all others more than half full.

Later in the evening all the drains were running full. On the 23d inst. all the drains were running a good stream at 11 A.M., and the discharge from the laterals continued until June 2, heavy showers having fallen on the 28th and 31st of May. The samples of drainage waters were taken to the laboratory, where they were analyzed under the supervision of Director Goessmann, with the results given in the following Table: —

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Composition of the Drainage-waters from the Experimental Corn Plats, May 22, 1883.

PLAT.	Time of taking Samples.	Parts per Million.							Grains per Gallon.			
		Free Ammonia.	Albuminoid Ammonia.	Total Ammonia.	Nitrogen as Ammonia.	Nitrogen as Nitrates.	Total Nitrogen.	$CaCo_3$ (Hardness).	Solids.	Potassium Oxide.	Phosphoric Acid.	Chlorine.
0,	11 A. M.	.13	.09	.22	.18	.70	.88	27.3	7.5	.18	Trace.	.4
0,	2.30 P. M.	.11	.06	.17	.14	–	.14	16.9	5.0	.15	Trace.	.4
1,	2.30 "	.08	.11	.19	.16	16.26	16.42	*	*	*	*	*
3,	11 A. M.	.01	.07	.08	.07	.27	.34	28.6	4.5	.13	Trace.	.5
3,	2.30 P. M.	.45	.06	.51	.42	.19	.61	19.5	2.5	.13	Trace.	.3
5,	2.30 "	.02	.07	.09	.07	–	.07	23 4	2.5	.11	Trace.	.3
7,	2.30 "	.01	.10	.11	.09	.05	.14	27.3	4.5	.18	Trace.	.3
9,	2.30 "	.02	.09	.11	.09	.06	.15	23.4	3.5	.14	Trace.	.4
11,	2 "	.01	.10	.11	.09	.09	.18	22.1	4.0	.09	Trace.	.2
13,	11 A. M.	.01	.08	.09	.07	.17	.24	22.1	4.0	.12	Trace.	.3
13,	2 P. M.	.01	.10	.11	.09	.13	.22	20.8	3.8	.21	Trace.	.3
15,	2 "	.01	.07	.08	.07	.03	.10	2.0	4.5	.04	Trace.	.3
17,	2 "	.01	.10	.11	.09	.05	.14	45.7	9.0	.07	Trace.	.3
19,	2 "	.01	.12	.13	.11	.17	.28	41.6	9.0	.31	Trace.	.4
C,	11 A. M.	.01	.12	.13	.11	.14	.25	18.2	2.3	.07	Trace.	.5
C,	2 P. M.	.01	.15	.16	.13	–	.13	15.6	3 3	.04	Trace.	.4
B,	2.30 "	.01	.11	.12	.10	.07	.17	18.2	2.5	.03	Trace.	.3

* Not determined.

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The exceptionally high yield of nitrogen in the drainage water from plat 1, as given in the Table, can only be explained on the supposition that the labels of the samples from plats 0 and 1, collected at 2.30 P.M., have been transposed, either when sampling in a pouring rain or afterwards. The composition of the sample of plat 1, as given in the Table, is approximately what might be expected in the sample from plat 0, from what is known of its characteristics and previous history. The record is, however, given as it was made, and future analysis of the drainage waters from these plats may explain the apparent anomaly.

There was quite as much nitrogen in the drainage waters of most of the plats as could reasonably be expected under the conditions and at the time of year when they were collected.

The soluble nitrogen of the soil had been washed out by the spring rains before the tiles were laid, and during the cold and backward spring the process of nitrification had not been carried on actively.

The composition of the drainage waters may have been somewhat modified by the conditions under which they were collected, as they were the first waters discharged by the tiles that had just been laid.

The season has been a remarkably dry one, and the drains have not been running since June 2.

The water table was raised to the grade of the main drain by the fall rains, but the laterals have remained dry.

To carry out these experiments in a manner that will secure the best practical results in the shortest time, three drain-gauges should be provided to determine the relations of the rainfall to the drainage under different conditions of management, — and laterals should be laid in the upper tier of plats, which should be devoted to crops in systematic rotation.

The entire expense of these additional facilities for experimenting will probably not exceed $450.

In a matter of so much importance to the farmers of the State, there should be no difficulty in securing the required appropriation.

It is certainly bad policy to buy fertilizers to supply a waste of the elements of fertility in the soil, which may be prevented by better methods of management; and these can only be determined by carefully conducted experiment.

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[Exhibit E.]

REPORT ON ENSILAGE.

Silo.

The silo, 10.5 by 14.1 feet, inside measure, and 11 feet deep, for experiments with ensilage, has been made in one corner of the feeding barn, and entirely above ground.

In its construction the aim has been to secure a practically air-tight box with the least possible expense.

The lower two feet of the silo is enclosed with brick walls, nearly two feet in thickness, which form on two sides the foundation walls of the building, the earth on the outside being graded nearly to the level of the sills.

Above the brick work the walls of the silo are made with six-inch studs, in contact with the sheathed and clapboarded covering of the barn on two sides, and the inner walls are covered with matched boards on the outside. The lining of the silo consists of two thicknesses of one-inch matched boards, nailed firmly to the studs, with sheets of tarred paper between them to make the walls as nearly air-tight as possible. In this way a dead-air space of six inches is secured in the walls on all sides.

Door.

The door of the silo, opening on the barn floor, is made of pieces of two-inch planks, planed to a thickness, and battened with a lining of one-inch planed boards. These pieces forming the door are placed crosswise of the doorway, fitting closely inside the jambs, with the inner surface flush with the inside of the wall of the silo. The door is kept in place by planed 2 by 4 scantling, fastened to the jambs of the doorway with square-headed screw bolts, technically called "lag-screws," to sustain the pressure of the ensilage on the door.

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By this arrangement access is gained to the ensilage by taking out the lag-screws with a wrench, and removing the scantling that support the door, and then taking the door out piece by piece, and thus exposing the wall of ensilage pressing against it.

The cover of the silo consists of a course of two-inch planed planks, cut five-eighths of an inch shorter than the diameter of the silo, and covered with a course of one-inch planed boards breaking joints with the planks. As the planed surface and edges of the boards and planks fit closely together, the cover is practically air-tight, with the exception of the slight space around the edges which must be left to prevent binding against the walls of the silo as the ensilage settles.

Weights.

The required pressure is obtained by means of cement barrels filled with earth.

Barrels or boxes of earth or stones are, in my experience, the best and most convenient weights for a silo, as they give a uniform and constant pressure. Screws are objectionable as they do not give a constant pressure and must be tightened once or twice a day for several weeks, and the labor involved is more than will be required to supply the needed load of earth or stones.

Fodder Corn.

The fodder corn for filling the silo was grown on the west tier of experiment plats, and on a small piece of ground west of the plats in experimental grasses.

No manure was applied, as the condition of the soil for future experiments was a matter of greater importance than a large crop of fodder corn this year.

"Longfellow" corn was sowed in drills thirty inches apart July 5. From the late time of planting, a small variety of corn was selected in preference to the larger sorts, which require a longer season to mature.

The corn made a rapid growth, and it was well tasselled out, when it was struck by the frost on the night of Sept. 3.

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As soon as help could be obtained the fodder corn was harvested and put in the silo, the cutting to 1¼ inch lengths being done by hand-power.

15212.5 pounds were cut and put in the silo Sept. 6; 13850.0 pounds were cut and put in the silo Sept. 7; and 5327.5 pounds, harvested the preceding day, were cut and put in the silo Sept. 8. The total of green fodder was 17 tons 390 lbs.

The corn was well tramped down as it was put in the silo, and at night when work was stopped the surface was carefully levelled and left without covering until morning.

The night of the 6th the mass settled about two inches, and on the night of the 7th it settled three inches.

The cover was put on and weighted with earth to give an estimated pressure of something over 60 pounds to the square foot, in the afternoon of the 8th.

The mass, before covering and weighting, filled the silo to the depth of 8½ feet, and the temperature two feet below the surface was 82° F.

Temperature.

For the convenience of future observations a gas pipe 1¼ inches in diameter and four feet long, with sharp edges, was driven through a hole in the middle of the cover, and the upper end was securely packed to make a tight connection with the planks of the cover, while the top was closed with a plug.

The temperature of the ensilage at the bottom of this tube, and the temperature of the air outside, together with the settling of the surface of the mass of ensilage, were frequently observed with the results given in the following table. Whenever a change in the temperature was noticed the observation was immediately repeated, to eliminate all possible errors. The observations on the depth of ensilage were taken from a single point until the 18th inst., when irregularities in the rate of settling were noticed, and the observations were afterwards taken from four points, the average of them being given in the table: —

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Observations on the Ensilage.

DATE.	Depth of Ensilage.	Temperature of Ensilage 4 ft. from the surface.	Temperature of Outside Air.	Remarks.
Sept. 8, . .	8 ft. 6 in.	82° F.	–	2 ft. below surface before covering.
" 9, . .	7 " 7 "	82° "	–	
" 10, . .	7 " 2¾ "	78° "	–	
" 11, . .	6 " 9 "	77° "	–	
" 12, . .	– –	82° "	62°	
" 14, . .	– –	84° "	55°	
" 15, . .	5 ft. 11½ in.	84° "	68°	
" 16, . .	5 " 11¼ "	87° "	72°	
" 17, . .	5 " 10½ "	85° "	69°	
" 18, . .	5 " 9¾ "	82° "	59°	
" 19, . .	5 " 9¾ "	84° "	–	
" 20, . .	5 " 9½ "	84° "	61°	
" 21, . .	5 " 9¼ "	84° "	62°	
" 22, . .	5 " 9 "	83° "	56°	
" 24, . .	5 " 9 "	82° "	61°	
" 25, . .	5 " 8½ "	80° "	58°	
" 26, . .	5 " 8¼ "	80° "	50°	
" 27, . .	5 " 7¾ "	80° "	50°	
" 28, . .	5 " 7½ "	80° "	60°	
" 29, . .	5 " 7¼ "	79° "	53°	
" 30, . .	5 " 7¼ "	78° "	59°	
Oct. 1, . .	5 " 7⅛ "	78° "	50°	
" 2, . .	5 " 7⅛ "	76° "	48°	
" 3, . .	5 " 7 "	76° "	44°	
" 4, . .	5 " 6⅞ "	76° "	43°	
" 10, . .	– –	68° "	–	
" 27, . .	– –	65° "	–	
Nov. 7, . .	– –	64° "	–	
" 18, . .	– –	59° "	–	
Dec. 3, . .	– –	54° "	–	
" 15, . .	5 ft. 5½ in.	49° "	22°	

It will be seen that the ensilage did not settle at a uniform rate, as might be expected from the constant pressure applied, and the variations are greater than can be attributed to errors of observation, as the measurements were taken with the greatest exactness, and they were repeatedly verified by re-measurement. Frequent examinations of the edges of the cover failed to detect any indication of obstruction by pressure on the walls of the silo.

Temperature.

The temperature of the ensilage on the 9th inst. was the same as on the previous day, before the cover was put on

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(82°), but there was a fall of 5° in the course of the next two days. A rise of temperature then followed, reaching the maximum of 87° on the 16th, and during the next two weeks there was a depression of but 9°. The fall in temperature in the following two and one half months was only 29° to the lowest observation recorded (49°), which is still above the temperature of the outside air.

Bacteria.

Samples of the ensilage were taken from time to time through the tube, at depths of from four to five feet below the surface, for microscopic examination.

The sample taken on the 9th inst., when the temperature was observed, swarmed with bacteria, which were remarkably active, and rapidly increasing by self-division.

Since the temperature has fallen below 60° the apparent activity of the bacteria has been slightly diminished. This may be attributed to the lower temperature and increasing acidity, but the relative influence of each has not been determined.

Fermentation.

There are two classes of ferments now generally recognized: 1st, the so-called soluble or chemical ferments, as acids and diastase, which "invert" cane sugar and transform it into dextrose, or change starch into dextrine, etc., and these, according to Dumas, "always sacrifice themselves in the exercise of their activities." 2d, The true ferments, which from the discoveries of Schwann (1838), and the elaborate and exhaustive experiments which have been made by Pasteur in the past twenty years, are now known to be living organisms that produce fermentation as a function of their vital activity.

The true fermentations are, therefore, purely physiological processes, which are defined by Pasteur as "the direct consequence of the processes of nutrition, assimilation and life, when they are carried on without the agency of free oxygen," or "as a result of life without air." Unlike the soluble ferments, these living organisms increase at the expense of the substances fermented.

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These organized ferments, which belong to the class of fungi, may be divided into two groups, the *Saccharomycetes* or budding fungi, — the active agents of alcoholic fermentation, of which yeast may be taken as the type; and the *Schizomycetes*, or fission fungi, which include the lactic, butyric, and similar ferments, and the ferments of putrefaction; most of them are of the forms known as bacteria, and they multiply rapidly by subdivision. All the members of both groups probably propagate by means of spores, but this method of reproduction has not been observed in many species belonging to the last mentioned group.

The living organisms of fermentation found in samples of fresh ensilage, all belong to the group of Schizomycetes (bacteria). No members of the group of Saccharomycetes (yeast or alcoholic fungi) have been observed in samples from the interior of the silo that had not been exposed to the air.

After the silo is opened and a large surface is exposed to the air, the "yeast fungi" and even the "moulds" may be found, but they are evidently the result of germs derived from the air after the silo is opened.

We do not include the "mould fungi" in the class of ferments proper, as Pasteur has shown that they act as ferments under exceptional conditions only, and even then they do not produce active fermentation.

The ferments of the first mentioned group have been studied more thoroughly than the others, from their importance in the manufacture of beer, wine, etc., but many of the facts developed in their investigation are undoubtedly applicable to the ferments of the other groups.

From experiments with fruits in an atmosphere of carbonic acid, Pasteur has apparently shown that any vegetable cells which are capable of extracting their needed supply of oxygen from organic combinations may, by this manifestation of their vital activity, act as ferments; and the true ferments are distinguished from these, not by a difference in their specification, but from the fact that they are capable of carrying on the functions of nutrition and assimilation with much greater activity without a supply of oxygen in the air.

Pasteur has likewise proved that the alcoholic ferments

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develop rapidly in the presence of air, but their function as ferments is impaired by this ready supply of oxygen.

In the absence of air, as in an atmosphere of carbonic acid, they take their supply of oxygen from organic substances, like sugar, and their function as ferments is increased.

When the life of the bacteria, or other organized ferments, is destroyed, the process of fermentation, or putrefaction, ceases; and this takes place, — according to the observations made in the course of the controversy in regard to spontaneous generation,— at a temperature of from 122° to 140°, and if the germs that produce the bacteria are then excluded, the process of fermentation, or of putrefaction, cannot again take place.

The canned articles of food, which are now so common in the markets, furnish an illustration of the application of this principle. In their preparation heat is applied, which kills the bacteria, — the active agents of fermentation, — and they are then sealed in air-tight cans to prevent the access of a fresh supply of germs from the atmosphere.

That the germs which produce the bacteria of fermentation and putrefaction are abundantly distributed in the air, has been conclusively proved by the experiments of Pasteur and Tyndall, and the supposed cases of spontaneous fermentation or putrefaction are readily explained by the seeding of the fermenting substances with the germs derived from the atmosphere.

The various and conflicting reports that are made in regard to the quality of ensilage, including the degree of acidity, its influence upon the quality of milk, and its general feeding value, can only be explained by differences in the quality and maturity of the crops from which it is made, together with the different methods of securing it, all of which must have an influence on the process of nutrition in the bacteria, and therefore produce variations in the results of fermentation.

The molecular changes taking place under such different conditions cannot be expressed in any definite chemical formula. As fermentation is strictly a physiological process, the fermented product may be looked upon as the *residuum*

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of what is required in the nutritive functions of the bacteria that produce it.

In advocating these views Pasteur says: "Originally, when fermentations were put amongst the class of decompositions by contact-action, it seemed probable, and, in fact, was actually believed, that every fermentation had its own well-developed equation, which never varied.

"In the present day, on the contrary, it must be borne in mind that the equation of a fermentation varies essentially with the conditions under which that fermentation is accomplished, and that a statement of this equation is a problem no less complicated than that in the case of the nutrition of a living being. To every fermentation may be assigned an equation in a general sort of way, — an equation, however, which in numerous points of detail is liable to the thousand variations connected with the phenomena of life. Moreover, there will be as many distinct fermentations brought about by one ferment as there are fermentable substances capable of supplying the carbon element of the food of that same ferment, in the same way that the equation of the nutrition of an animal will vary with the nature of the food which it consumes. As regards fermentation producing alcohol, which may be effected by several different ferments, there will be, in the case of a given sugar, as many general equations as there are ferments, whether they be ferment-cells, properly so called, or cells of the organs of living beings functioning as ferments. In the same way the equation of nutrition varies in the case of different animals nourished on the same food. These remarks are applicable to all ferments alike; for instance, butyric ferment is capable of producing a host of distinct fermentations, in consequence of its ability to derive the carbonaceous part of its food from very different substances, from sugar, or lactic acid, or glycerine, or mannite, and many others. Moreover, it is quite erroneous to suppose that the presence of a single one of the products of a fermentation implies the co-existence of a particular ferment. If, for example, we find alcohol among the products of a fermentation, or even alcohol and carbonic acid gas together, this does not prove that the ferment must be an alcoholic ferment, belonging to alcoholic fermentations

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in the strict sense of the term. Nor, again, does the mere presence of lactic acid necessarily imply the presence of lactic ferment. As a matter of fact, different fermentations may give rise tc one or even several identical products."

From this statement of the physiological conditions that modify the products of fermentation, it must be seen that uniformity in the quality of ensilage can only be secured by preventing fermentation altogether, or reducing it within the narrowest possible limits. This can only be done by destroying the bacteria of fermentation in the earliest stages of their activity, which would result in the production of ensilage free from acidity, and closely resembling in quality the green fodder from which it is made.

If the bacteria can be killed, when the silo is covered and weighted, the enclosed mass of ensilage will be practically preserved under the same conditions as fruits, or vegetables, or meats are preserved when canned. The practical question, then, presents itself as to how this can best be accomplished.

An extended series of observations on samples of the ensilage from the experimental silo, have already been made, and are still in progress, to determine the temperature required to kill the bacteria which are the cause of fermentation. This will, without doubt, vary somewhat with the kind of produce under treatment and its condition at the time of harvest. Thus far my experiments seem to indicate that a temperature of from 115° to 122°, maintained for one or two hours, will be sufficient to kill the bacteria under the conditions in which they are now placed.

The time of exposure, as well as the temperature, must have an important influence on the result.

A degree of heat that would kill the mature and active bacteria would not, in all probability, kill the germs which might produce a succeeding generation if the given temperature was continued but a short time.

From observations on the temperature of the silo after it was covered and weighted, it may with reason be expected that the initial temperature will remain nearly constant for several days, and perhaps for weeks, which would ensure the destruction of any successive generations of bacteria that

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might be developed from the germs that had not been killed.

In the ordinary process of filling a silo the object aimed at is to prevent fermentation by keeping the green fodder well packed as it is put in, and even under these precautions the temperature of the mass often rises above 100°. I have observed a temperature of 105° when the greatest care had been taken in packing the silo as it was filled.

With less tramping of the mass, and when the work of filling the silo is extended over a period of several days, the temperature may rise to a point that is fatal to the bacteria; and this may be the explanation of the reported cases in which the ensilage is said to be "sweet," or free from acidity.

When the precise conditions as to the required temperature are known, the better plan may be to fill the silo without any packing beyond what is produced by the weight of the superincumbent mass, and then allow it to remain until the desired temperature is reached, before putting on the cover and weights.

The best method can, however, only be determined by carefully conducted experiments that are made with a full knowledge of the different conditions that may have an influence in modifying the results. It cannot, however, be doubted that acidity in the ensilage can only be produced by conducting the process so that the temperature does not rise above the point that is fatal to the bacterial ferment (probably 115° to 120°).

In filling silos, observations on temperature have been generally neglected, and we therefore lack the necessary data for determining the precise temperature required to prevent fermentation, or the conditions under which it may be produced, from the results of practical experience. But a single case has come to my knowledge, where such observations have been made, when the resulting product was sweet ensilage. Mr. George Fry of England reports the results of some experiments made the present season, which are of particular interest in connection with the observations recorded above.

In a silo, filled with "rough grass" and "clover and rye

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grass" between the 7th and 30th of June, the temperature at the time of covering was 132°, at a depth of six feet from the surface. The cover was weighted with twelve inches of sand.

On July 11th, and again on the 17th, the cover was taken off and the silo was filled with "meadow grass" to make up for the loss in settling.

The temperature observed at these dates was 140° at a depth of six feet from the surface.

In another silo, filled with "clover and rye grass" and "meadow grass" between June 30th and July 11th, when the cover was put on and weighted, the temperature observed was—July 7th, 149°, and July 14th, 158°. The first-mentioned silo was opened October 25, and the ensilage is described as "of a brown color, and of a sweet, luscious odor, *free from acidity*, very much resembling that of ordinary hay." Cattle, sheep, and horses ate it at once with apparent relish.

These experiments seem to prove that a temperature sufficiently high to kill the bacteria and put a stop to fermentation can be readily obtained in the process of filling the silo.

Experiments are now needed to determine the precise temperature required and the most favorable conditions for securing it with different articles of food.

Ensilage in the Silo.

To carry on the experiments now in progress, the ensilage in the experimental silo should not be fed out until some time in March.

Additional facilities will be required to complete the investigations that are now in progress. An appropriation of $100.00 will be sufficient to provide the necessary outfit.

An engine is very much needed to furnish power for cutting fodder, and for other purposes, — a suitable one, with the necessary shafting and belting, may be procured at a cost not exceeding $500.

Amherst, Mass., Dec. 24, 1883.

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[Exhibit F.]

EXPERIMENTS WITH PIGS.

The experiments in pig-feeding have been limited to some preliminary inquiries in regard to the influence of bran and cotton-seed meal when added to a ration composed principally of corn-meal.

As bran and cotton-seed meal contain a higher percentage of proteids than corn-meal, they should be valuable additions to the ration, if corn-meal as a fattening food is deficient in nitrogenous constituents. Ten pure-bred Berkshire pigs, from the College farm, were put in the experimental pens on the afternoon of October 23, but one pig being put in each pen. The age, sex, and weight of each pig is given in the following table: —

No. 1,	Sow,	weight,	October 23,	58¾ lbs.	Born May 16, 1883.
" 3,	"	"	"	59¾ "	
" 5,	Barrow,	"	"	59¼ "	
" 7,	"	"	"	42¼ "	
" 9,	"	"	"	68¼ "	From two to three weeks older.
" 10,	"	"	"	70 "	
" 8,	"	"	"	61¼ "	
" 6,	Sow,	"	"	67½ "	
" 4,	Barrow,	"	"	60¼ "	
" 2,	"	"	"	59¼ "	

For a preliminary period of five days, while getting accustomed to their new quarters, the pigs were all fed on corn-meal.

At the beginning of the experiment, on the morning of October 29, they were all again weighed, before feeding, and were then put on their assigned rations as follows: —

Nos. 5 and 6, — Corn-meal only.
Nos. 1, 2, and 8, — Corn-meal with cotton-seed meal.
Nos. 3, 7, and 4, — Corn-meal with bran.
Nos. 9 and 10, — Corn-meal with bran and cotton-seed meal.

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A limited ration of bran and cotton-seed meal was given in the pens having the mixed food, and the corn-meal was fed to make out the full ration of as much as would be readily eaten.

The bran and cotton-seed meal were not apparently relished on the start, and the amount fed was determined in each case by the quantity that would be eaten with a good appetite.

An analysis of the feed was made in the laboratory, under the supervision of Director Goessman, which showed the composition to be as follows: —

	Corn-Meal.	Bran	Cotton-Seed Meal.
Moisture, at 100° C., ...	13.55	12.08	8.38
Crude Ash, ...	1.23	6.96	7.80
" Cellulose, ...	2.28	12.06	6.17
" Fat, ...	3.67	3.35	1[illegible].85
" Protein, ...	8.99	13 78	38.91
Non-nitrogenous Extract, . . .	70.28	51.77	26.89
	100.00	100.00	100.00

To prevent any possible deficiency in the ash constituents, in feeding growing pigs with corn-meal alone, and to secure uniformity in all conditions, aside from the differences in food, leached ashes, with a few small pieces of charcoal, were kept in a separate trough in each pen, to which the pigs had uninterrupted access.

The weight of each pig at the beginning of each week, the feed consumed per week, and the average weight of each pig for each week, will be found in Tables 1, 2, and 3.

The amount of dry substance of food consumed per week by each pig, the amount of dry substance of food required to produce one pound of increase in live weight, and the gain for each 100 pounds of live weight, or the gain per cent. for each week, is given in Tables 4, 5, and 6.

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Table No. I.

Weight of Each Pig at beginning of Preliminary Period, Oct. 23, and at the beginning of Each Week of the Experiments, — Weights taken Monday Mornings before feeding, from Oct. 29, 1883, — in Pounds and Decimals of a Pound.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23,	58.75	59.75	59.25	42.25	68.25	70.0	67.5	61.25	60.25	59.25
" 29,	58.0	61.0	61.5	43.5	71.5	71.0	70.0	63.75	62.00	63.25
November 5,	60.5	68.5	59.5	46.5	78.0	77.75	73.5	67.75	65.00	72.75
" 12,	68.0	73.5	57.	47.5	85 5	81.25	82.75	75.25	71.25	76.00
" 19,	73.0	81.75	63.5	54.0	91.75	90.5	87.5	81.25	78.00	83.75
" 26,	77.0	87.0	70.0	57.0	103.75	95.5	104.25	90.5	85.00	92.00
December 3,	81.0	86.0	76.75	58.5	109.0	101.5	97.0	97.25	91.50	87.00
" 10,	79.5	87.5	84.5	59.0	115.5	104.0	105.5	104.5	98.00	83.5
" 17,	77.	87.5	85.0	60.0	121.0	103.0	102.25	110.0	-	-

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Table No. 2.

Feed Consumed, per Week, by each Pig in Pounds and Decimals.

PERIOD.	1.		3.		5.	7.		9.			10.			8.		6.	4.		2.	
	Corn-meal.	Cotton-seed Meal.	Corn-meal.	Bran.	Corn-meal.	Corn-meal.	Bran.	Corn-meal.	Bran.	Cotton-seed Meal.	Corn-meal.	Bran.	Cotton-seed Meal.	Corn-meal.	Cotton-seed Meal.	Corn-meal.	Corn-meal.	Bran.	Corn-meal.	Cotton-seed Meal.
Preliminary period, Oct. 23 to 29, .	16.75	-	18.75	-	20.5	16.5	-	21.5	-	-	21.	-	-	22.13	-	21.5	20.13	-	20.13	-
Week ending Nov. 5, . . .	15.31	2.85	20.5	5.88	20.75	9.5	5 75	21.	5.75	2.88	19.5	5.44	2.66	18.16	2.13	27.31	21.	5.63	23.63	3.94
Week ending Nov. 12. . . .	15.88	2.63	24.94	5 25	11.13	10.5	5.25	21.	5.25	2.63	19 75	4 94	2.47	24.19	3.25	27.56	21.	5.25	21.13	3.94
Week ending Nov. 19, . . .	15.75	2.63	24 94	5.25	15.69	10.5	7.75	20.5	4.88	2.56	20.25	4.81	2.53	18 63	3.81	28.19	21.	5.25	21.	3.94
Week ending Nov 26, . . .	17.25	2.63	24.94	5.25	23.13	10.5	7.88	21.	5.25	2 63	19.	4.75	2.38	23.13	5.25	28.88	21.	6.56	18.5	3.47
Week ending Dec. 3, . . .	18.38	2.63	19.13	4.13	26.69	10.5	9.19	20.5	5.13	2.56	18.	4.5	2.1	18.	3 63	30.63	21.	7.88	14.25	2.79
Week ending Dec. 10, . . .	18.56	2 44	12 63	3.69	29.94	10.5	7.69	21.	5.25	2.63	15.75	3.94	1.31	18.	3.69	32.56	21.	7.88	7.06	1.94
Week ending Dec. 17, . . .	11.63	.88	15.88	2.	20.94	11.25	4.06	20 25	6.34	2.56	15.44	1.88	1.	15.75	1.13	28.13	-	-	12.	-

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TABLE No. 3.

Average Weight of Pigs for Each Week in Pounds and Decimals.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to October 29, . . .	58.38	60.38	60.38	42.88	69.88	70.50	68.75	62.5	61.13	61.25
Week ending November 5, . . .	59.25	64.75	60.50	45.00	74.75	74.38	71.75	65.75	63.5	68.00
" " " 12, . . .	64.25	71.00	58.25	47.00	81.25	79.50	78.13	71.5	68.13	74.38
" " " 19, . . .	70.5	77.63	60.25	50.75	88.63	85.88	85.13	78.25	74.63	79.88
" " " 26, . . .	75.0	84.38	66.75	55.5	97.75	93.00	95.88	85.88	81.50	87.88
" " December 3, . . .	79.0	86.5	73.38	57.8	106.4	98.50	100.6	93.9	88.30	89.5
" " " 10, . . .	80.25	86.75	80.63	58.75	112.25	102.75	101.25	100.83	94.75	85.25
" " " 17, . . .	78.25	87.5	84.75	59.5	118.25	103.5	103.88	107.25	–	–

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TABLE NO. 4.

Dry Substance of Feed consumed, per Week, for each 100 lbs. of Live Weight in Pounds and Decimals.

DATE—1883.	1	3	5	7		10	8	6	4	2
October 23 to 29, . . .	24.8	26 9	29.4	33.3	26.7	25.8	27.9	29.8	28.5	28.5
Week ending November 5, .	25.1	35 3	29.2	31.6	35.3	32.7	24.6	35.9	36.5	30.1
" " " 12, . .	25.2	35.5	16.6	29 2	31 0	28.7	30.6	33.4	33.4	29.7
" " " 19, .	22.7	32.5	24.2	31.3	26.4	28.1	21.8	31.2	30.5	27.3
" " " 26,	23.1	29.7	33.0	28.8	25.8	24 6	25.9	29.1	29.4	16.8
" " December 3, . . .	23 2	23.4	31.5	28.1	23.1	21.8	23.0	28.2	28.4	16 7
" " " 10, . . .	22.8	15.3	32.2	26.9	22.4	17.9	17.7	27.9	26.4	9.5
" " " 17, . . .	13.9	18.3	21.4	22.4	21.5	15.4	13.1	23.8	-	-

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TABLE No. 5.

Dry Substance of Feed consumed required to produce 1 lb. of increase of Live Weight.

DATE—1883.	1	3	5	7	9	10	8	6	4	2
October 23 to 29, ...	*	11.6	7.9	11.4	5.7	18.2	7.7	7.4	9.4	4.4
Week ending November 5, . . .	5.5	3.0	*	4.6	4.0	3.6	5.1	5.9	7.7	2.3
" " " 12, . . .	2.1	5.0	*	13.7	3.4	6.7	2.6	3.2	3.6	6.7
" " " 19, . . .	3.2	3.1	2.2	2.4	3.9	2.9	3.9	4.1	3.4	2.8
" " " 26, . . .	4.4	4.8	3.1	5.3	2.1	4.6	1.5	2.7	3.4	1.7
" " December 3, . . .	4.6	*	3.4	10.9	4.7	3.6	*	3.9	3.9	*
" " " 10, . . .	*	8.8	3.3	32.0	3.9	7.4	2.1	3.9	3.9	*
" " " 17, . . .	*	*	36.2	13.3	4.6	*	*	4.4	–	–

* No gain.

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TABLE No. 6.

Gain per 100 lbs. of Live Weight per Week.

DATE—1882.	1	3	5	7	9	10	8	6	4	2.
October 23 to 29	—1 3	2.1	3.8	3.0	4.8	1.4	3.7	4.1	5.0	6.8
Week ending November 5, . . .	3.4	12 3	—4.1	6.9	9.1	9.5	5.0	6.3	4.8	15.0
" " " 12, . . .	12.39	7.3	—2 5	2.2	9.6	4.5	12 6	11.1	9.6	4.5
" " " 19, . . .	7.3	11.2	11.4	13.1	7.3	11.4	5.7	8.0	9.5	10.2
" " " 26, . . .	5.3	6.2	9.8	5.4	12.3	5.4	17.5	10.8	8.6	9.4
" " December 3, . . .	5.2	—1.2	9.6	2.6	5.1	6.3	—7.6	7.5	7.6	—5.9
" " " 10, . . .	—1.9	1.7	10.1	0.9	6.0	3.4	8.7	7.4	7.1	—4.
" " " 17, . . .	—3.1	0.	0.6	1.7	4.8	—1.0	—3.1	5.2	-	-

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In the diagrams which follow, some of the leading facts recorded in the tables are presented in the graphic form, so that the results can be more readily compared.

The different pigs, and the kind of feed consumed by them, is indicated on all the diagrams as follows: —

A black line is given for pigs 5 and 6, which were fed corn-meal only.

A blue line is given for pigs 1, 2 and 8, which were fed corn-meal with cotton-seed meal.

A red line is given for pigs 3, 7 and 4, which were fed corn-meal with bran.

An interrupted line, blue and red, is given for pigs 9 and 10, which were fed corn-meal with bran and cotton-seed meal.

A scale at the side of the diagrams will show the weights indicated.

On diagram 1, the actual weight of each pig is given for each week, and the gain or loss can be readily traced.

In diagram 2, the initial weights are reduced to a common standard of one hundred pounds, and the lines show the gain or loss for each week for each one hundred pounds of live weight.

The dry substance of feed consumed per week, for each one hundred pounds of live weight, is given in diagram 3, and the dry substance of food consumed, required to produce one pound of increase in live weight, is given in diagram 4.

It will be noticed that the weights of pigs 4 and 2 are omitted in the tables and diagrams the last week of the experiment. No. 4 seemed to be in perfect health, when weighed on the morning of December 10, but a few minutes after he fell down in a "spasm," and died within ten minutes of the first attack, apparently of apoplexy. The only post-mortem indications of disease consisted in congestion of the membranes of the brain and medulla.

An examination will show that, in the uniform rate of gain during the experiment, — in the comparatively slight variations in the amount of food consumed in proportion to its weight, — and in the return for feed consumed, he had made one of the best records in the experiment.

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Diagram 1. Weight of each pig at the beginning of the preliminary period – Oct. 23rd – and at the beginning of each week of the experiment.

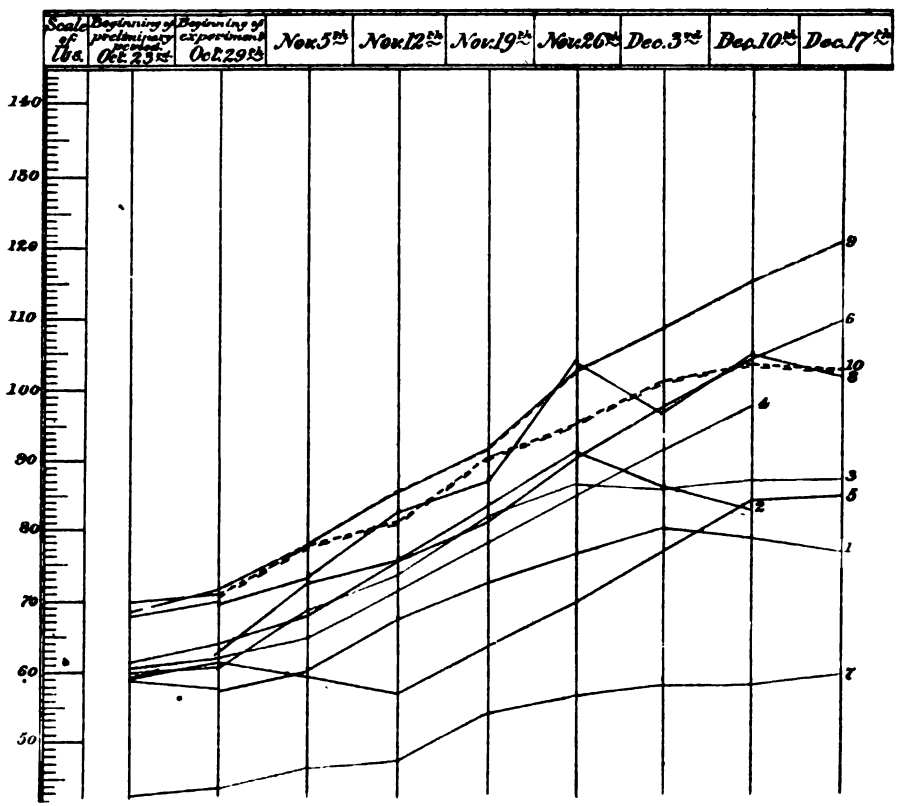

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Diagram 2. Gain per each 100 lbs. of live weight per week, or gain per cent.

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Diagram 3. Dry substance of feed consumed, per week, for each 100 lbs. of live weight.

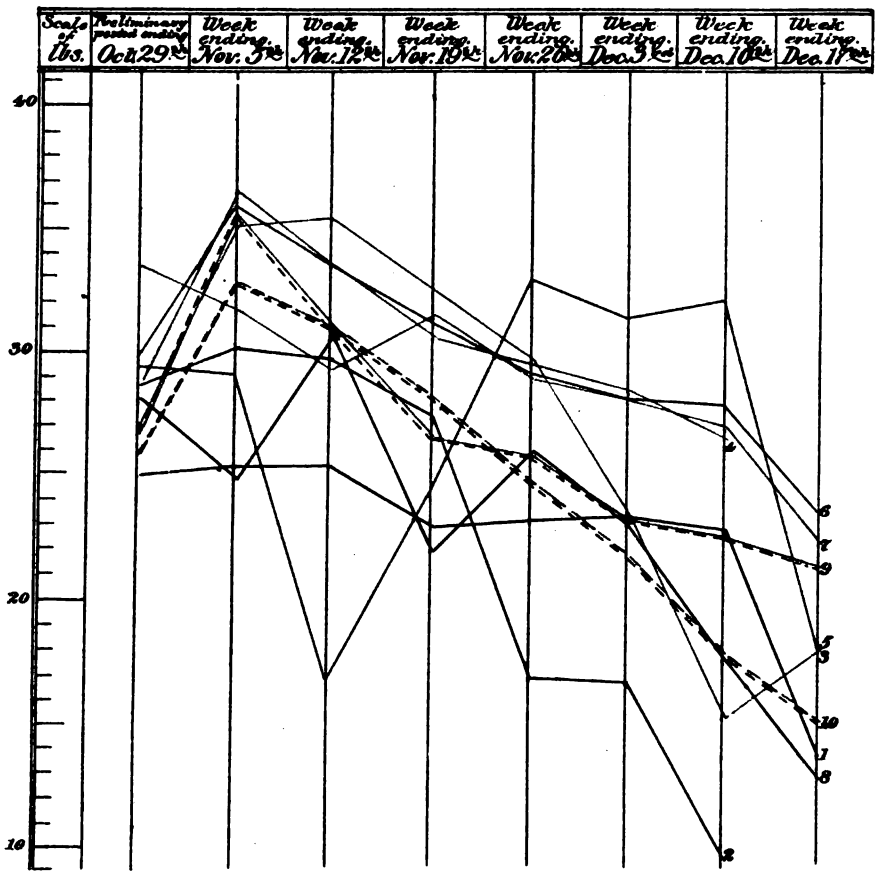

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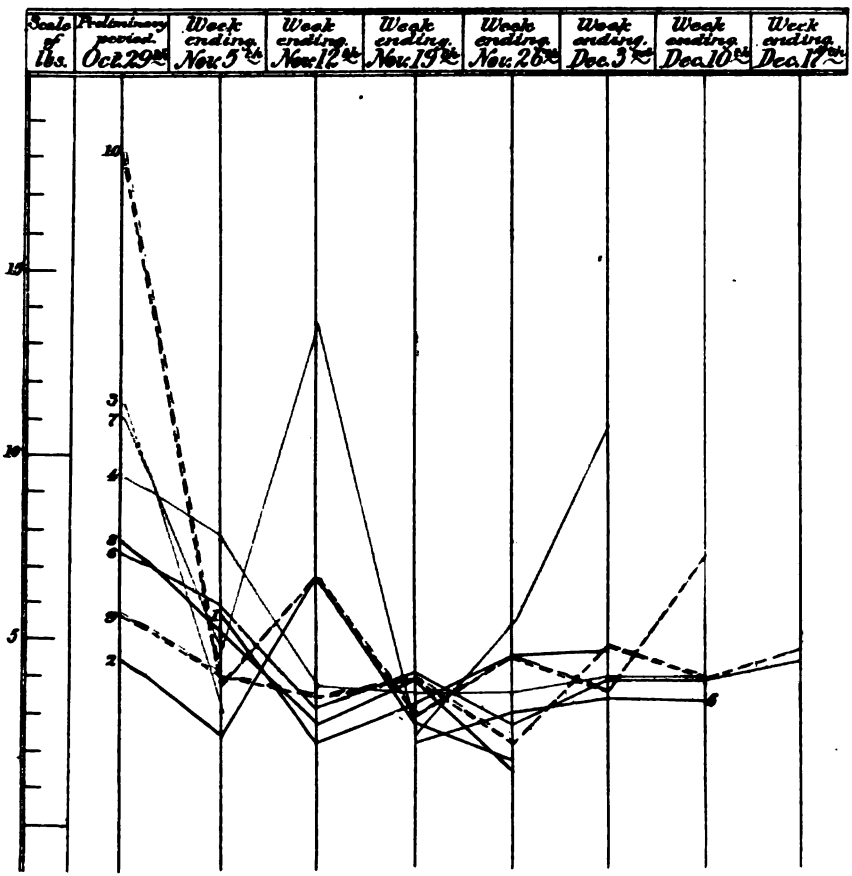
Diagram 4. Dry substance, of food consumed, required to produce 1 lb. of increase of live weight.



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A rheumatic affection of the hind legs of pig No. 2, accompanied with tenderness of the muscles and partial loss of motion, had been noticed for a few days at the close of the experiment, and he was not, therefore, weighed on the 17th.

The weather during the last week of the experiment was severe, the feed freezing in the troughs, and the thermometer, at times, nearly down to zero. Under these conditions, but two pigs (9 and 6) made a positive gain.

Pig No. 5 was sick, and lost weight the first two weeks of the experiment, which accounts for the low consumption of food recorded in table 2 and diagram 3, — during the next four weeks, however, with an exclusive diet of corn-meal, he made, on the whole, the best record, as will be seen by reference to table 5 and diagram 4.

The diagrams show that the feed required to produce a pound of increase in live weight varies from week to week, with the same food, and of the rations fed there is no particular one which seems to have an advantage, in this respect, over the others.

On the whole, the experiments fail to prove that corn-meal with bran or cotton-seed meal, or both, is a more valuable pig food than corn-meal alone.

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HORTICULTURAL DEPARTMENT

OF

MASSACHUSETTS EXPERIMENT STATION.

To the Director and Board of Control.

GENTLEMEN: — The special work assigned to this department, and upon which I make the following report, is as follows: —

I. THE GROWTH AND CARE OF THE COLLECTION OF GRASSES AND FORAGE CROPS.

II. THE CARE OF THE FRUIT PLATS FOR DETERMINING THE EFFECT OF THE VARIOUS ELEMENTS OF PLANT-FOOD UPON THE COMPOSITION OF THE FRUIT.

III. TESTING THE VARIOUS KINDS OF NEW FRUITS.

IV. TO DETERMINE WHAT INFLUENCE THE STOCK MAY HAVE UPON THE SCION, IF ANY, IN GRAFTING.

V. STUDY OF DISEASES OF FRUIT AND OTHER TREES AND PLANTS, AND THE REMEDIES TO BE APPLIED.

VI. DESTRUCTION OF INJURIOUS INSECTS.

VII. GERMINATION OF SEEDS.

I.

Upon the land leased the Station by the College was found a collection of grasses and forage plants, consisting of the following species: —

Perennials.

Alopecurus pratensis,	Meadow foxtail.
Phleum pratense,	Timothy.
Dactylis glomerata,	Orchard grass.
Bromus secalinus,	Chess or cheat.
Bromus mollis,	Soft chess.
Bromus giganteus,	Great chess.
Lolium perenne,	Rye-grass.
Festuca elatior,	Meadow fescue.

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Festuca ovina,	Sheep's fescue.
Festuca duriuscular,	
Festuca rubra,	Red fescue.
Festuca tenella,	Slender fescue.
Festuca gigantea,	Great fescue.
Agrostis vulgaris,	Red-top or Eng. bent.
Agrostis stolonifera,	Creeping bent.
Agrostis canina,	R. I. bent.
Poa pratense,	June-grass or Ky. blue-grass.
Poa trivialis,	Rough-stalked meadow.
Poa serotina,	False red-top.
Poa compressa,	Wire-grass.
Anthoxanthemum odoratum,	Sweet vernal.
Avena flavescens,	Yellow oat-grass.
Arrhenatherum avenaceum,	Wild oat-grass.
Aira cæspitosa,	Hair-grass.
Aira flexuosa,	Hair-grass.
Phalaris arundinacea,	Reed canary-grass.
Holcus lanatus,	Meadow soft-grass.
Calamagrostis Canadensis,	Blue-joint grass.

Annuals.

Phalaris Canariensis,	Canary-grass.
Solium Italicum,	Rye-grass.
Panicum Germanicum,	Hungarian millet.
Panicum Italicum,	Common millet.
Panicum miliaceum,	Golden millet.
Avena sativa,	Common oat.
Secale cereale,	Rye.
Triticum vulgare,	Wheat.
Hordeum vulgare,	Barley.
Sorghum vulgare,	Amber cane, Chinese, etc.

Leguminous.

Vicia sativa,	Vetch.
Lupinus perennis,	Blue lupine.
Lupinus luteus,	Yellow lupine.
Lupinus albus,	White lupine.
Trifolium pratense,	Red clover.
Trifolium hybridum,	Alsike clover.
Trifolium repens,	White clover.
Trifolium incarnatum,	Italian clover.
Mileletus albus,	Bokhara clover.
Lotus corniculatus,	Birdsfoot clover.
Medicage sativa,	Lucerne.
Ornithopus sativa,	Saradella.
Dolichos sinensis,	Cow-pea, var's "Whippoorwill and Clay."

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The last mentioned was added to the collection this season.

The growth of the majority of the above has not been as good as could be desired, owing to the time they have been growing, — three or four years, — and many weeds have worked into the plats; so that, after gathering such specimens as were desired for analysis, they were ploughed under, and the collection will be increased as much as possible, and replanted early next spring.

The cow-peas and vetch were sown with oats and rye; but owing to the lateness of the season when the seed arrived, the growth was not sufficiently large to give a fair basis for determining their value.

II. Experimental Fruit Plats.

The trees and small fruits in these five plats have been under treatment for several years, and have yielded some fruit, which has been gathered for analysis.

The five plats into which the land was divided were planted with the same kinds of fruit in each; *i. e.*, apples, pears, peaches, plums, cherries, blackberries, raspberries, grapes, strawberries, currants and gooseberries, and is a good example of what may be done in close planting for a family fruit garden.

Four plats were fertilized with different elements of plant-food, and the fifth was left in its natural condition. The analyses of the fruit taken from these, made by Director Goessmann, and given in his previous reports, prove conclusively that the composition of fruits can be greatly affected by the application of special fertilizers.

The growth of the trees and plants has been very good; in fact, in some cases greater than is desirable for their most healthy development. This was especially the case with some of the peach trees, in which the growth of wood was so great and continued so late that it failed to mature, and the fruit buds were injured last winter, so that no fruit was borne the past season, while upon land less highly fertilized the trees produced large crops of fruit.

During the fall of 1881, and the winter of 1882, many of the trees in these plats were destroyed by cold, and all suf-

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fered more or less, but no trace of the disease known as the *yellows* has made its appearance.

The soil upon which these trees are planted is a medium sandy loam, and well adapted to the growth of all kinds of fruits except the currant and quince.

III. Testing New Varieties of Fruits.

The soil to be devoted to this purpose is, like the above, well suited to the growth of all of the fruits except the currant and quince. The land has been prepared, and a few varieties of peach and apple trees planted.

IV. Influence of the Stock upon the Scion.

This experiment has only been started with some of the large fruits, but it is proposed to begin also with the smaller fruits and plants that require less time for development and maturity.

V. Diseases of Plants.

The time given to this subject has been largely in continuation of the study of the disease of the peach tree known as the *yellows*, which has for several years been carried on under the auspices of the college. In order to more fully understand the present condition of the experiment, I will give a brief history of the trees and the special treatment they have received.

The orchard originally consisted of about fifty trees, planted in 1870. For the first few years they received but little care. In the spring of 1873 all were carefully pruned to as good form as their condition would allow, the borers removed, and the soil manured and planted with squashes. The result was, that after a year or two they bore a good crop of fruit. After fruiting, many of the trees showed signs of disease, and a series of experiments were instituted with six or eight trees in 1878. The remarkable change made in these trees led to the continuance of the remedies upon all the peach trees in the college orchards that showed signs of disease. The results of the application of the remedies, when applied before the disease had made too great headway, have been entirely satisfactory; so much so

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that most of the original trees are now in a healthy condition, although they have been thoroughly diseased, and the past season have borne as perfect fruit as is often produced by young trees.

Young trees have been planted where diseased trees were dug out, and the past season bore fruit. They are as healthy and vigorous as any trees in the orchard.

The remedies applied have been muriate of potash, from two to five pounds to the tree, sown in the fall or early spring, with ground bone or superphosphate, according to the condition of the soil, which, if very poor, should have an additional dressing of organic matter, like stable manure. In addition to these remedies, the borers (the larvæ of the moth, *Ægeria exitiosa*) have been dug out with a knife twice each year, — in June and August, — and the trees kept cut back to a close, compact form. The pruning is always done in the fall or winter, and the last season's growth is cut back one-half. In cases where the tree is weak and straggling in growth, many of the large, long branches are cut back to give it good form.

The results of all of our experiments with plant life lead us to the belief, although it may not now be susceptible of positive proof, that the fungus growth generally found in diseased plants only develops after the tissues have become deranged or injured by some external cause, as cold following a season of immature growth, exhaustion caused by overbearing or drought, exhaustion of the soil, or injuries from insects.

In every instance where proper remedies have been applied *in time*, the trees have recovered and made a good growth.

The chemical side of these experiments will be fully given by Dr. Goessmann.

The questions of *pear blight* and *rust* on the blackberry and raspberry have received attention, but the results are not fully complete, and will be reserved for a future report.

VI. Destruction of Injurious Insects.

The work in this line has been confined to means of destruction of the currant worm (*Eufitchia riberia*); the cab-

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bage worm (*Pieris rapæ*); the plum weevil, or plum curculio (*Conotrachelus nenuphar*); the Colorado potato beetle (*Dophora decem-lineata*); and the rose bug (*Macrodactylus subspinosa*).

The various insecticides used were powdered hellebore, pyrethrum powder, carbolate of lime, lime and kerosene, and lime and sulphur. The above were used in the dry form and in liquid.

The Currant Worm.

This worm is the larva of a moth about three-fourths of an inch across, which destroys the foliage soon after it unfolds, and again about the time the fruit begins to ripen. It was destroyed very quickly by the hellebore and pyrethrum. The latter, being more rapid in its action, and entirely free from poisonous qualities, can be used without danger at any time. The results of application of the other insecticides were not satisfactory, and further experiment as to their value must be made at some future time.

The Cabbage Worm.

The only effectual and easily applied remedy found for this insect was the pyrethrum powder. This applied dry destroyed the worms very quickly, even when mixed with five times its bulk of common plaster. It was applied by means of a pair of common sulphur bellows with a curved nose, a single movement of the bellows being sufficient to send the dust over all parts of the inside of the plant. Insecticides applied in liquids did not prove satisfactory, on account of the peculiar structure of the surface of the leaves of the cabbage, which causes the liquid to roll off in drops. This remedy proved most effectual when extended with an equal bulk of plaster.

Curculio, or Plum Weevil.

All the remedies applied for the destruction of this pest were ineffectual in saving a single specimen of fruit from some twenty trees that bloomed and set a large crop.

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It is hoped, however, that by further experiments with the same remedies and other substances something may be found that will save this crop, either by being offensive to or by the destruction of the insects. In the meantime the certain but laborious method of jarring the trees and destroying the insects and the fruit containing their larvæ, or that of planting the trees in poultry yards, must be resorted to.

The Potato Beetle.

The effect of the pyrethrum powder on the larvæ of this beetle was to paralyze for a time, but not to kill them.

The Rose Bug.

This is another insect that our remedies, in a measure, failed to destroy or to prevent wholly from destroying the grape crop and rose blossoms. Pyrethrum has the effect of paralyzing them for a time, and by repeated applications, several times each day, may prove effectual.

Kerosene and lime, dry, seemed offensive to them, but they returned in a short time. Further experiments are required to fully determine its value.

In the use of carbolic acid, kerosene, and sulphur, they were slacked with caustic lime and applied in form of powder or in liquids.

The liquids used for the distribution of insecticides were water and buttermilk; the latter causing the substances to adhere to the foliage for a long time; in some cases three weeks or more.

An examination was made to determine the cause of the dropping of the apple crop, and it was found, in eight hundred specimens examined when from one-half of an inch to one inch in diameter, that all but three of this number were punctured, and contained one or more eggs or larvæ of the plum weevil, and only a very few contained the larvæ of the codling moth, which is so destructive later in the season.

VII. Germination of Weed Seeds.

Material for these experiments was collected during the summer and autumn, and arrangements are already made for

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testing the germinating power of various kinds of seeds, especially troublesome weed seeds, at different stages of ripeness, and also under various conditions, the report of which will be made for one of the early monthly bulletins.

S. T. MAYNARD,
Professor of Botany and Horticulture,
Massachusetts Agricultural College.

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ANNUAL REPORT OF THE CHEMIST.

I. Fodder and Fodder Analyses.

To ascertain the composition of our fodder articles, as far as the character and relative proportion of their essential proximate constituents are concerned, is the first step towards the introduction of a rational system of feeding our farm live stock.

A better knowledge of what we feed enables us to give a more judicious explanation of the results of our feeding experiments; it teaches best how to supplement our own fodder resources to meet the special wants of our farm stock, and cannot fail to direct the attention of the producer of fodder crops to the important question whether they are, as far as quality is concerned, what they ought to be. Actual feeding experiments have shown that the condition and quality of the soil exert a decided influence, not only on the quantity, but also on the quality of the crops raised upon it. For instance, oats raised during the same season upon the same kind of soil, with the aid of manures and without them, have been noticed to contain in the latter case as low as five, and in the former as high as eleven, per cent. of nitrogenous constituents in its dry vegetable matter.

The existence of similar relations between the particular condition of the soil and the composition of the crops, has been proved in regard to most of our prominent grasses and leguminous plants, as clover, as well as of mixed forage crops, like meadow hay.

A high percentage of nitrogenous constituents in these crops is usually accompanied by a high percentage of phosphoric acid compounds.

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As both are known to exert a decidedly beneficial influence on the absolute and relative nutritive value of a single article of fodder, may it be an entire plant, or a particular part of it, it needs scarcely any farther argument to prove that an economical system of feeding our farm stock ought to begin with an intelligent cultivation of our leading fodder crops. We ought to raise them with a view to promote the special development of their most valuable nutritive constituents; and to select the crops for cultivation with reference to the particular adaptation of soil, climate and location *to favor the production of the best of its kind.* The introduction of a greater variety of fodder crops cannot fail to assist materially in gaining the desirable end. To raise good potatoes for family use, or good sugar-beets for the sugar manufacturer, requires a different condition of the soil, as far as the character of its accumulated plant-food is concerned, than to raise both crops of a superior quality for feeding purposes.

A mealy potato is usually rich in starch and, comparatively speaking, deficient in nitrogenous matter; and sugar-beets, best adapted for the manufacture of sugar, are rich in sugar, and contain a low percentage of nitrogenous constituents; they yield to the manufacturer the largest amount of sugar at the lowest expense.

The garden-farmer and manufacturer of sugar judge the quality of their respective crops by a standard quite different from that of the farmer who, engaged in general farming, considers stock-feeding an important part of his industry.

To compound an economical and suitable diet for any class of farm animals requires not only a general knowledge of the composition of the fodder on hand, but also a fair acquaintance with the relative proportion of the three groups of essential nutritive constituents they are apt to contain under different conditions of the soil. This kind of information is as essential for the guidance of the experimenter as the knowledge of the special wants of the animal with reference to its organization, age and functions. The wide range of variations in composition which has been noticed in our leading fodder crops when raised upon rich or ex-

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hausted lands, renders many of our current tabular statements of the chemical composition of the more prominent articles of fodder of *doubtful merit in the hands of the farmer, who considers them an unfailing guide in his special case.*

The majority of these fodder tables may be traced to one source (E. Wolff). They state the mean of a smaller or larger number of analyses, quite frequently made without any intention to ascertain the possible variations in the composition of the article under investigation. The analytical statements themselves refer in the majority of cases to plants raised in Germany, and in other European countries. Whilst the great value of these Tables from an agricultural educational standpoint must be conceded, their analytical statements require qualification before they may be safely relied on in home practice. The Annual Report of the Secretary of the Massachusetts State Board of Agriculture for 1882, pages 104–114, contains a tabular statement of the composition of many fodder crops, giving the extremes (highest and lowest percentages found), with reference to each group of nutritive constituents. (Julius Kühn.)

This mode of stating the composition of the various farm crops tends to direct the attention more decidedly towards the advantages arising from a proper cultivation of fodder crops.

The Experiment Station has entered upon a systematic course of investigation to assist in determining the influence of stage of growth and of cultivation on the feeding value of some of our prominent forage plants.

The chemical analysis of any article of fodder begins usually with the determination of its moisture, and of the amount of *dry matter* left behind when heated to a temperature not exceeding 110° C., or 230° F., until a constant weight is obtained. The proximate constituents of the dry matter are subsequently reported with reference to the special relation they bear towards the support of animial life. Liebig's classification of the constituents of a complete animal food into *three distinct nutritive groups* of *compounds*, namely, nitrogen containing organic substances (*nitrogenous substances, crude protein*), non-nitrogenous, containing organic sub-

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stances (carbo-hydrates) and mineral matter, is still recognized in the general arrangement of the analytical results of the examination. As more recent investigations have shown a superior physiological value of the fat,* — one of the non-nitrogenous constituents, — as compared with starch, sugar, and other representatives of that group, its amount is separately recorded. The same course, for similar reasons, has been of late adopted with reference to certain soluble forms of nitrogenous organic constituents of fodder articles.

In the subsequent analytical statements of examinations carried on at the Station, crude fat refers to the non-volatile residue of the ether abstract of the dried material; and crude protein refers to the nitrogen obtained by the soda lime test, multiplied by 6.25. The substances were in every case reduced to a uniform size, by passing them through a metal sieve, 144 mesh to the square inch.

The general course of analysis was the customary one, introduced by Henneberg and Stohman. Each analysis, as far as possible, is accompanied with a statement of the ratio of digestibility of the various groups of fodder constituents, ascertained in some well-conducted feeding experiments.

Records of this kind cannot fail to assist in forming a more intelligent opinion regarding the real nutritive portion of the fodder we feed.

* See, for details, "Influence of Chemistry on a Rational System of Stock Feeding," in the Thirtieth Annual Report of the Massachusetts State Board of Agriculture (1882–83), pages 89 to 125.

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II. Analyses of Fodder.

DRIED FODDER CORN—(Frost-Bitten).

[From the Farm of the Experiment Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.83	176.6	–	–	1 : 9.82
Dry Matter,	91.17	1,823.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.86	92.7	–	–	
" Cellulose,	29.05	581.0	418.32	72	
" Fat,	2.06	41.2	30.90	75	
" Protein (Nitrogenous Matter),	8.63	172.6	126.00	73	
Non-nitrogenous Extract Matter,	55.40	1,108.0	742.36	67	
	100 00	2,000.0	1,317.58	–	

The sample was taken from unmanured fields, September 5, 1883, after a serious frost. The material for analysis was dried by artificial means. The bulk of the crop was put into a silo. The corn showed only the tassel, no silk having yet appeared. It was turned into ensilage at an earlier stage of growth than was originally intended. The dry matter contained in fodder corn, between showing the tassel and maturing the kernel, may vary from 12 to 18 per cent. and more.

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CORN STOVER — (FROST-BITTEN).

[From Unmanured, Underdrained Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.73	174.6	–	–	1 : 16.67
Dry Matter,	91.27	1,825.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	3.12	62.4	–	–	
" Cellulose,	34.28	685.6	356.51	52	
" Fat,	1.27	25.4	7.11	28	
" Protein (Nitrogenous Matter),	6.58	131.6	48.69	37	
Non-nitrogenous Extract Matter,	54.75	1,095.0	438.00	40	
	100.00	2,000.0	850.31	–	

The kernels were not fully matured in consequence of the frost.

FODDER CORN (1).

[Sent by THOMAS J. FIELD, Northfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	6.65	133.0	–	Not determined by actual feeding experiment.	–
Dry Matter,	93.35	1,867.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	4.68	93.6	–		–
" Cellulose,	31.39	627.8	–		–
" Fat,	1.42	28.4	–		–
" Protein (Nitrogenous Matter),	6 83	136.6	–		–
Non-nitrogenous Extract Matter,	55.68	1,113.6	–		–
	100.00	2,000.0	–		–

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FODDER CORN (2).—(FROST-BITTEN.)

[Sent by THOMAS J. FIELD, Northfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	6.67	133.4	–	–	–
Dry Matter,	93.33	1,866.6	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash,	5.11	102.2	–	–	–
" Cellulose,	33.75	675.0	–	–	–
" Fat,	1.11	22.2	–	–	–
" Protein (Nitrogenous Matter),	6.17	123.4	–	–	–
Non-nitrogenous Extract Matter,	53.86	1,077.2	–	–	–
	100.00	2,000.0	–	–	–

The history of the above two samples of fodder corn, as far as their respective stages of growth and their mode of cultivation, etc., is concerned, has not been reported.

The analytical results show some difference in composition in favor of No. 1, yet hardly enough, under existing circumstances, to encourage a discussion of the effects of frost in this particular case. The sample of frost-bitten corn, after careful drying, proves still of a fair composition. The particular stage of growth and the character of the weather exert a controlling influence on the degree of changes in composition.

The effects of frost are usually more serious in the earlier periods of the life of the plants than in their more matured states. Dry, cool weather, after a frost, causes less alteration in composition than sultry, warm weather. Frost-bitten green fodder corn is best preserved in silos.

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CORN-MEAL.

[Collected of Chas. Parsons, Northampton, Mass.]

93.25 parts passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	17.04	340.80	–	–	1 : 5.54
Dry Matter,	82.96	1,659.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1 58	31.60	–	–	
" Cellulose,	3.60	72.00	24.48	34	
" Fat,	4.82	96.40	73.26	76	
" Protein (Nitrogenous Matter),	16.80	336.00	285.60	85	
Non-nitrogenous Extract Matter,	73.20	1,464.00	1,376.16	94	
	100.00	2,000.00	1,759.50	–	

Essential Mineral Constituents in 100 Parts of Corn-meal.

Potassium oxide,	0.419
Calcium oxide,	0.040
Magnesium oxide,	0.176
Phosphoric acid,	0.644

The above rate of digestibility was found in feeding experiments with pigs.

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CORN-MEAL.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Ninety-two per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.55	271.0	–	–	
Dry Matter,	86.45	1,729.0	–	–	
	100 00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.42	28.4	–	–	
" Cellulose,	2.64	52.8	17.95	34	1 : 9.66
" Fat,	4.24	84.8	64.45	76	
" Protein (Nitrogenous Matter),	10.40	208.0	176.80	85	
Non-nitrogenous Extract Matter,	81.30	1,626.0	1,528.44	94	
	100.00	2,000.0	1,787.64	–	

The article is a fair specimen of its kind. As a more detailed discussion of the composition of corn may not be without some interest in this connection, I refer to the results of an examination of eleven prominent Eastern, Western, and Southern varieties, which have been published in the annual report of the Massachusetts State Board of Agriculture for 1879. The samples of corn which served for my investigation were furnished by well-known parties. The mode of cultivation and of manuring was stated, and the material had been collected with care. The analytical work was carried on with a view of securing results of a strictly comparative value. They were stated with reference to a corresponding amount of moisture, to render differences in composition prominent at sight. The actual demonstration of the influence of the particular condition of the soil on the feeding value of the same variety of corn raised upon it (independent of varying quantity) deserves a serious consideration.

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CORN-MEAL AND COBS.

[Collected of CHAS. PARSONS, Northampton, Mass.]

78.63 per cent. passed through mesh of 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	19.07	381.40	-	Not determined by actual feeding experiment.	-
Dry Matter,	80.93	1,618.60	-		-
	100 00	2,000.00	-		-
Analysis of Dry Matter.					
Crude Ash,	1.61	32.20	-		-
" Cellulose,	9 77	195.40	-		-
" Fat,	3.43	68.60	-		-
" Protein (Nitrogenous Matter),	15.06	301.20	-		-
Non-nitrogenous Extract Matter,	70.13	1,402.60	-		-
	100.00	2,000.00	-		-

The rate of digestibility of corn cobs has been stated of late by E. Wolff as follows: 42 per cent. of protein, 52 per cent. of non-nitrogenous matter, and 30 per cent. of the fat. Whether these values are the results of actual feeding experiments, or an approximation by this distinguished author, I am not prepared to decide. There is but little doubt, however, that the addition of cobs to meal deserves recognition in regard to their nutritive value as well as to their beneficial mechanical influence upon the digestion of the corn-meal. For analysis of corn cobs, see report of Mass. Board of Agriculture for 1879, pages 240–244.

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NEBRASKA RED CORN.

[Sent from Franklin County, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.74	214.8	–	–	1 : 6.97
Dry Matter,	89.26	1,785.2	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.44	28.8	–	–	
" Cellulose,	3.36	67.2	22.85	34	
" Fat,	6.05	121.0	91.96	76	
" Protein (Nitrogenous Matter),	14.16	283.2	240.72	85	
Non-nitrogenous Extract Matter,	74.99	1,499.8	1,424.81	95	
	100.00	2,000.0	1,780.34	–	

A comparison of the above stated analytical results, with those previously referred to, show a high nutritive value for the red variety. Whether this result is mainly due to a high state of fertilization of the soil which served for its production, or to an inherent superiority of this variety of corn, further observation can only decide.

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HOMINY FEED.

[Chit and Soft Parts of the Kernel of the Corn, collected of J. A. SULLIVAN, Northampton, Mass.]

46.07 per cent. passed through mesh, 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.93	178.60	–	Not determined by feeding experiment.	–
Dry Matter,	91 07	1,821.40	–		–
	100.00	2,000.00	–		–
Analysis of Dry Matter.					
Crude Ash,	2.07	41.40	–		–
" Cellulose,	3.77	75 40	–		–
" Fat,	4.89	97.80	–		
" Protein (Nitrogenous Matter,	11.20	224.00	–		
Non-Nitrogenous Extract Matter,	78.07	1,561.40	–		–
	100.00	2,000.00	–		–

Essential Mineral Constituents in 100 parts of Hominy Feed.

Potassium oxide,	0.49	per cent.
Calcium oxide,	0.18	"
Magnesium oxide,	0 28	"
Phosphoric acid,	0.98	"

The rate of digestibility is probably similar to that of corn-meal.

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GLUTEN MEAL (1).

[Refuse from Glucose Manufacture from Messrs. SUMNER CROSBY & SON, South Boston, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.43	168.6	–	Not ascertained by actual experiment.	–
Dry Matter,	91.57	1,831.4	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	.64	12.8	–		–
" Cellulose,	3.55	71.0	–		–
" Fat,	8.75	175.0	–		–
" Protein (Nitrogenous Matter,	38.22	764.4	–		–
Non-Nitrogenous Extract Matter,	48.84	976.8	–		–
	100.00	2,000.0	–		–

Essential Mineral Constituents in 100 parts of Gluten Meal.

Potassium oxide,	0.0564
Calcium oxide,	0.0582
Magnesium oxide,	0.0346
Phosphoric acid,	0.4512
Sulphuric acid,	0.0215

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GLUTEN MEAL (2).

[Refuse from Glucose Manufacture sent by NEWTON & FULLER, Springfield, Mass.]

Eighty-three per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C,	10.23	204.6	-	Not determined by actual experiment.	-
Dry Matter,	89.77	1,795.4	-		-
	100.00	2,000.0	-		-
Analysis of Dry Matter.					
Crude Ash,	.65	13.0	-		-
" Cellulose,	1.20	24.0	-		-
" Fat,	5.06	101.0	-		-
" Protein (Nitrogenous Matter,	33.56	671.4	-		-
Non-nitrogenous Extract Matter,	59.53	1,190.6	-		-
	100.00	2,000.0	-		-

Both articles were of a good mechanical condition. A comparison of the first and second analysis shows that the latter contained 3 per cent. of fat and 5 per cent. of nitrogenous matter less than the former, whilst its soluble non-nitrogenous constituents exceed that of the former about 10 per cent. No free sulphuric acid was noticed in either case. The rich nitrogenous character of the "gluten meal" places it between the brans of our grains and the oil cakes, and alongside of our leguminous seeds, as beans, pease, etc. Its peculiarity, as compared with the above fodder articles, consists in the low percentage of mineral constituents, a point which requires a careful consideration in its application. It ought to be fed with coarse articles of fodder, rich in mineral matter.

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HAY OF BLACK GRASS (1).

[The following six samples of hay were sent by the Secretary of the Rowley Farmers' Club, Rowley, Essex County, Mass., in April, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.22	204.40	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.78	1,795.60	–		–
	100.00	2,000.00	–		–
Analysis of Dry Matter.					
Crude Ash,	8.63	172.6	–		–
" Cellulose,	24.78	495.6	–		–
" Fat,	1.52	30.4	–		–
" Protein (Nitrogenous Matter),	9.39	187.8	–		–
Non-nitrogenous Extract Matter,	55.68	1,113.6	–		–
	100.00	2,000.0	–		–

The grass was cut before blooming on the 24th of June, 1882; it would have matured, according to the letter of the secretary, by the 10th of July. The hay had been housed as soon as cured.

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HAY OF BLACK GRASS (2).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.15	263.0	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	86.85	1,737.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	6.50	130.0	–		–
" Cellulose,	28.66	573.2	–		–
" Fat,	1.20	24.0	–		–
" Protein (Nitrogenous Matter,	7 15	143.0	–		–
Non-nitrogenous Extract Matter,	61.49	1,129.8	–		–
	100.00	2,000.0	–		–

The grass which served for the production of hay No. 2 was cut when it began to look red, — approaching maturity, — July 24th, 1882, and was housed as soon as cured.

HAY OF HIGH MARSH GRASS (3).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	11.05	221 0	–	–	–
Dry Matter,	88.95	1,779.0	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash,	6.18	123.6	–	–	–
" Cellulose,	24.81	496.2	–	–	–
" Fat,	0.98	19.6	–	–	–
" Protein (Nitrogenous Matter),	6.14	122.8	–	–	–
Non-nitrogenous Extract Matter,	61.89	1,237.8	–	–	–
	100.00	2,000.0	–	–	–

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The grass was cut in July, 1882, and stored when cured. No statement was made with reference to the particular stage of growth of the grass at the time of cutting.

HAY OF LOW MARSH GRASS (4).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	10.97	219.4	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.03	1,780.6	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	8.19	163.8	–		–
" Cellulose,	28.82	576.4	–		–
" Fat,	2.22	44.4	–		–
" Protein (Nitrogenous Matter),	6.79	135.8	–		–
Non-nitrogenous Extract Matter,	53.98	1,079.6	–		–
	100.00	2,000.0	–		–

The grass was cut in August, 1882, and stacked as soon as cured.

HAY OF LOW MARSH GRASS (5).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.25	205.0	–	Not ascertained by actual feeding experiment.	–
Dry Matter,	89.75	1,795.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	5.42	108.4	–		–
" Cellulose,	26.00	520.0	–		–
" Fat,	2.63	52.6	–		–
" Protein (Nitrogenous Matter),	7.19	143.8	–		–
Non-nitrogenous Extract Matter,	58.76	1,175.2	–		–
	100.00	2,000.0	–		–

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The grass was cut in the middle of August, and housed as soon as cured.

HAY OF LOW MARSH GRASS (6)

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., ...	13.30	266.0	-	Not ascertained by actual feeding experiment.	-
Dry Matter, ...	86.70	1,734.0	-		-
	100.00	2,000.0	-		-
Analysis of Dry Matter.					
Crude Ash, ...	6.05	121.0	-		-
" Cellulose, ...	27.19	543.8	-		-
" Fat, ...	2.90	58.0	-		-
" Protein (Nitrogenous Matter), ...	7.17	143.4	-		-
Non-nitrogenous Extract Matter, ...	56 69	1,133.8	-		-
	100.00	2,000.0	-		-

The grass was cut September 9th, and stacked when cured. It was injured somewhat by rain, and by the sea water.

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Analysis of Dry Matter of the Hays sent on by the Rowley Farmers' Club, and of an Average Quality of good Inland Meadow Hay.

	Hay of Black Grass, No. One.	Hay of Black Grass, No. Two.	Hay of High Marsh Grass, No. Three.	Hay of Low Marsh Grass, No. Four.	Hay of Low Marsh Grass, No. Five.	Hay of Low Marsh Grass, No. Six.	Hay of genuine Grasses in Full Blossom (H. Weiske).
Crude Ash,	8.63	6.50	6.18	8.19	5.42	6.05	8.55
" Cellulose,	24.78	23.66	24.81	28.82	26.00	27.19	27.61
" Fat,	1.52	1.20	0 98	2.22	2.63	2.90	5.02
" Protein (Nitrogenous Matter),	9.39	7.15	6.14	6.79	7.19	7 17	12.69
Non-nitrogenous Extract Matter,	55.68	61.49	61.89	53.98	58.76	56.69	46.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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The various samples of marsh or "salt hay," which served for the above analyses, were supplied by different members of the club; they arrived in good condition, and had evidently been collected with care. The individual plants, however, were in a condition which did not allow a satisfactory determination of their botanical names, and of the relative proportion of the various kinds of plants present, nor of their particular stage of growth. The communication received from the secretary of the club has to furnish, for this reason, the basis for a few subsequent remarks. A small collection of the upper portion of marsh meadow plants, neatly fastened upon suitable paper, accompanied the hay samples. To each specimen of this collection was attached its local name, with some general remarks as follows: —

"No. 1, — Sedge grass, grows on low spots.
"No. 2, — Branch grass.
"No. 3, — Goose grass, stalks with seeds.
"No. 4, — Fox, or red grass, the most common salt grass.
"No. 5, — Marsh mallows, called by some rosemary.

"These varieties of plants are generally found more or less mixed in all salt marshes. On marshes that have been ditched, a grass called white-top — by some called red-top — comes in and grows together with the above-stated fox grass. This white-top is nearly as early as 'black grass,' which is one of our earliest grasses, and the only one which grows distinct by itself."

As grass, like "rushes" and "sedges," exerts a controlling influence on the local character, and thus the comparative feeding value of the hay obtained from different places, it has to be conceded that the absence of a more detailed information regarding the particular character and condition of the vegetation, etc., which served for the production of the above-described hay samples, imparts to our analytical results in the majority of cases (from three to six) a mere local interest. A comparison of the various samples seems to confirm the prevailing impression that the "black grass" (*Juncus bulbosus*) furnishes a valuable fodder; and that

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carefully secured marsh hay in many instances, as far as composition is concerned, compares favorably with a large proportion of hay from "inland" meadows. There is scarcely another fodder crop on record of which the feeding value depends so much on a judicious management of the farmer as in the case of hay.

The first requirement for an intelligent examination concerning the comparative value of a fodder plant, or part of a plant, consists in securing specimens of a corresponding stage of growth. Adding to this a due consideration of the various circumstances under which the plants under examination are raised, results are attainable which may claim a general interest.

I take the liberty of suggesting, in this connection, to communicate rather with the officer in charge of the Station, before sending material of a similar character, and of asking an investigation of a subject of similar importance. The best interest of the farmers and of the Station will be served by adopting that course.

The fact that our opinion regarding the actual and relative feeding value of many of our fodder crops is still largely based on mere chance analyses, instead of on a systematic inquiry regarding our chances of securing the best results, is one of the principal impediments of arriving at a more settled opinion regarding a more rational management of feeding our farm live stock.

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HAY OF WINTER RYE.*

[Sent by JOHN E. RUSSELL, Secretary of Massachusetts Board of Agriculture.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.55	171.0	–	–	
Dry Matter,	91.45	1,829.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.40	128.0	–	–	1:8.28
" Cellulose,	32.97	659.4	–	–	
" Fat,	2.57	51.4	23.65	46	
" Protein (Nitrogenous Matter),	10.66	213.2	121.52	57	
Non-nitrogenous Extract Matter,	47.40	948.0	948.00	100	
	100.00	2,000.0	1,093.17	–	

The sample was cut May 25, 1883, when in full blossom. It is of a fair quality, and compares well with a medium good quality of meadow hay. The ratio of digestibility stated in connection with the non-nitrogenous extract matter of the hay, includes that of the crude cellulose, or raw fibre.

Green winter rye in blossom may contain from 20 to 26 per cent. of vegetable matter, and from 80 to 74 per cent. of water.

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TIMOTHY HAY.

[From the Experimental Farm]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . . .	8.70	174.0	–	–	–
Dry Matter, ...	91.30	1,826.0	–	–	–
	100.00	2,000 0	–	–	–
Analysis of Dry Matter.					
Crude Ash, ...	4.04	80.8	–	–	–
" Cellulose, ...	36.59	731 8	–	–	–
" Fat, ...	2.12	42.4	–	–	–
" Protein (Nitrogenous Matter), ...	7.24	144 8	–	–	–
Non - nitrogenous Extract Matter, ...	50 01	1,000.2	–	–	–
	100.00	2,000.0	–	–	–

The hay was harvested in July, after blooming. The sample was taken from the barn in November.

HAY OF RIPE OATS.

[From the Experimental Farm.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C., . . .	8.70	174.0	–	–	–
Dry Matter, ...	91.30	1,826.0	–	–	–
	100.00	2,000 0	–	–	–
Analysis of Dry Matter.					
Crude Ash, ...	6.11	122.2	–	–	–
" Cellulose, ...	36.31	726.2	–	–	–
" Fat, ...	2.61	52.2	–	–	–
" Protein (Nitrogenous Matter), ...	6.05	121.0	–	–	–
Non - nitrogenous Extract Matter, ...	48.92	978 4	–	–	–
	100.00	2,000.0	–	–	–

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The material for analysis consisted of the entire matured plant, and was collected August 26, 1883.

HAY OF OATS.

[From one of the Experimental Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	6.43	128.6	-	-	1 : 14.24
Dry Matter,	93.57	1,871.4	-	-	
	100.00	2,000 0	-	-	
Analysis of Dry Matter.					
Crude Ash,	6.41	128.2	-	-	
" Cellulose,	34.06	681.2	-	-	
" Fat,	2.92	58.4	26.86	46	
" Protein (Nitrogenous Matter),	6.58	131.6	75.01	57	
Non-nitrogenous Extract Matter,	50.03	1,000.6	1,000.60	100	
	100.00	2,000.0	1,102.47	-	

The sample was collected August 1, 1883, when in full blossom. It contained 74 per cent. of moisture, and 26 per cent. of dry matter. Its composition as shown by analysis can scarcely be called a fair one. The dry matter of oats in blossom may vary from 15 to 26 per cent.

Actual feeding experiments have shown that the condition and quality of the soil, aside from season and climate, exert a decided influence not only on the quantity, but also upon the quality of the crops raised upon it.

The analyses of our rye, oats and timothy previously described, were made with a view to ascertain the condition of the land which has passed under the control of the Station.

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RYE BRAN.

[Collected of CHAS. PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.70	274.00	–	–	1: 4.39
Dry Matter,	86.30	1,726.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.17	103.40	–	–	
" Cellulose,	4.54	90.80	8.17	9.	
" Fat,	2.07	41.40	23.80	57.5	
" Protein (Nitrogenous Matter),	18 98	379.60	250.54	66.	
Non-nitrogenous Extract Matter,	69.24	1,384.80	1,031.68	74.5	
	100.00	2,000.00	1,314.19	–	

The above ratio of digestibility of the various constituents was ascertained in feeding experiments with pigs.

WHEAT BRAN.

[Collected of CHAS. PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	13.70	274.00	–	–	1: 3.30
Dry Matter,	86.30	1,726.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.76	135.20	–	–	
" Cellulose,	9.33	186 60	37.32	20	
" Fat,	2.91	58.20	46.56	80	
" Protein (Nitrogenous Matter),	19.56	391.20	344.26	88	
Non-nitrogenous Extract Matter,	61 44	1,228.80	983.04	80	
	100.00	2,000.00	1,411.18	–	

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The above rate of digestibility was ascertained by feeding the dry material to steers.

WHEAT BRAN.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Thirty-three per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	12.08	241.6	–	–	1 : 4.16.
Dry Matter,	87.92	1,758.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.92	158.4	–	–	
" Cellulose,	13.72	274.4	54.88	20	
" Fat,	3.81	76.2	60.96	80	
" Protein (Nitrogenous Matter),	15.67	313.4	275.79	88	
Non-nitrogenous Extract Matter,	58.88	1,177.6	942.08	80	
	100.00	2,000.0	–	–	

The article is of a fair composition.

LINSEED CAKE.

[From Indiana.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C,	8.35	167.00	–	–	1 : 1.62
Dry Matter,	91.65	1,833.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.52	150.40	–	–	
" Cellulose,	8.69	173.80	45.19	26	
" Fat,	5.69	113.80	103.56	91	
" Protein (Nitrogenous Matter),	37.25	745.00	648.15	87	
Non-nitrogenous Extract Matter,	40.85	817.00	743.47	91	
	100.00	2,000.00	1,540.37	–	

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Essential Mineral Constituents in 100 parts Linseed Cake.

Potassium oxide,	1.43	per cent.
Calcium oxide,	0.64	"
Magnesium oxide,	0 77	"
Phosphoric acid,	1.86	"

The stated ratio of digestibility was ascertained by feeding experiments with steers.

COTTON-SEED MEAL.

[Collected of CHARLES PARSONS, Northampton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	9.13	182 60	–	–	1 : 1.23
Dry Matter,	90.87	1,817.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.61	152.20	–	–	
" Cellulose,	6.28	125.60	28.89	23	
" Fat,	12.83	256.60	233 51	91	
" Protein (Nitrogenous Matter),	47.04	940.80	696.19	74	
Non - nitrogenous Extract Matter,	26.24	524.80	241.41	46	
	100.00	2,000.00	1,200.00	–	

The percentage of nitrogenous constituents is exceptionally high.

The above rate of digestibility is based on experiments with sheep.

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COTTON-SEED MEAL.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Eighty-nine per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8 38	167.6	–	–	1 : 1.41
Dry Matter,	91.62	1,832.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	8.51	170.2	–	–	
" Cellulose,	6.73	134.6	30 82	23	
" Fat,	12.94	258.8	235 51	91	
" Protein (Nitrogenous Matter),	42.47	849.4	628.56	74	
Non-nitrogenous Extract Matter,	29.35	587.0	270.02	46	
	100.00	2,000.50	1,164.91		

A very good article as far as composition and mechanical conditions are concerned.

COTTON-SEED MEAL (1).

[Sent by J. E. SOPER & Co., Boston.]

Eighty-six per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.10	142.0	–	–	1 : 1.44
Dry Matter,	92.90	1,858 0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	9.34	186.8	–	–	
" Cellulose,	7.53	150 6	34.63	23	
" Fat,	13.75	275.0	250.25	91	
" Protein (Nitrogenous Matter),	42.58	851.6	630.18	74	
Non-nitrogenous Extract Matter,	26.80	536.0	246.56	46	
	100.00	2,000.0	1,161.62	–	

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The composition of the above article does not materially differ from previous analyses; the variations are within the limits noticed in fair samples of cotton-seed meal. Its mechanical condition was of a superior character. The meal was produced, according to the statement of the dealer, by a new process, "Roller-Process," and sifted.

COTTON-SEED MEAL (2).

[Sent by J. E. Soper & Co., Boston.]

Eighty-one per cent. passed through mesh, 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	8.15	163.0	–	–	1:1.88
Dry Matter,	91.85	1,837.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.46	149.2	–	–	
" Cellulose,	7.41	148.2	34.09	23	
" Fat,	14.72	294.4	267.90	91	
" Protein (Nitrogenous Matter),	36.54	730.8	540.79	74	
Non-nitrogenous Extract Matter,	33.87	677.4	311.60	46	
	100.00	2,000.0	1,154.38	–	

The article was obtained by the old (press) process. The sample which served for analysis (1) was of a better mechanical condition than (2). A comparison of samples (1) and (2) show their difference, due rather to the fact that different lots of cotton-seed served for the production of the article tested, than to a different process of grinding. The two modes of producing cotton-seed meal ought to be tried on the same lot of seeds, to render their respective merits conspicuous.

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COTTON-SEED MEAL.

[Sent by E. S. Warner, Hatfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.09	141.8	–	–	1 : 1.46
Dry Matter,	92.91	1,858.2	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	9.15	183.0	–	–	
" Cellulose,	10.53	210.6	48.44	23	
" Fat,	13.65	273.0	248.43	91	
" Protein (Nitrogenous Matter),	41.64	832.8	616.27	74	
Non-nitrogenous Extract Matter,	25.03	500.6	230.28	46	
	100.00	2,000.0	1,143.42	–	

The article is of good quality, and was obtained by bolting a coarse cotton-seed meal. Eighty-one pounds of the above was obtained from one hundred pounds of the latter. The coarse portion — nineteen per cent. — has been analyzed to ascertain its fitness as a fertilizer with the following results: —

Coarse portion of Cotton-Seed Meal for fertilizing purposes.

(Sent by E. S. Warner, Hatfield, Mass.)

	Per cent.
Moisture, at 100° C.,	7.09
Organic and volatile matter,	93 465
Ash constituents,	6.535
	100.000

	Per cent.
Nitrogen in organic compounds,	5.900
Potassium oxide,	1 797
Calcium oxide,	0.263
Magnesium oxide,	0.223
Phosphoric acid,	2.341
Insoluble matter,	1 784

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Valuation per ton of two thousand pounds: —

118	pounds of nitrogen, at 18 cents,	$21 24
46.82	pounds of phosphoric acid, at 6 cents,	2 69
35.94	pounds of potassium oxide, at 4¼ cents,	1 53
		$25 46

COCOA DUST.

[Refuse from Cocoa Manufacture, sent from Boston, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	7.10	142.0	–	Not determined by actual experiment.	–
Dry Matter,	92.90	1,858.0	–		–
	100.00	2,000.0	–		–
Analysis of Dry Matter.					
Crude Ash,	6 83	136.6	–		–
" Cellulose,	5.86	117.2	–		–
" Fat,	25.85	517.0	–		–
" Protein (Nitrogenous Matter),	15.47	309.4	–		–
Non-nitrogenous Extract Matter,	45.99	919 8	–		–
	100.00	2,000.0	–		–

Essential Mineral Constituents in 100 Parts of Cocoa Dust.

Potassium oxide,	2.11
Calcium oxide,	.63
Magnesium oxide,	traces
Phosphoric acid,	1.34

The material consisted of the inside and outside parts of the cocoa bean, with some foreign matter. It was obtained in the process of cracking and sifting the bean. The examination was made by request, to ascertain its fitness for manuring. Although its nitrogen percentage (2.3 per cent.) compares well with many fertilizers in our market, it would be, for economical considerations, more advisable to try the cocoa dust as a fodder in place of oil-bearing seeds. The reputation of the cocoa as a highly nutritive food for man is too well established to doubt the efficiency of the above described article as a fodder for some kind of farm stock.

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III. — Miscellaneous Analyses.

EXAMINATIONS OF SKIM MILK FOR FAT.

[Samples sent on at different times for examination.]

	Sample Numbers.									
	1	2	3	4	5	6	7	8	9	10
Amount of fat in 100 parts, ...	.26	.31	.38	.30	.38	.37	.35	.48	.54	.48

Analysis of Milk from Shorthorn Cow.

	Per cent.
Moisture, at 100° C., ...	88.45
Solid matter, ...	11.55
	100.00
Ash percentage, ...	0.72

One hundred parts of ash contained—

	Per cent.
Potassium oxide, ...	23.52
Sodium oxide, ...	14.20
Calcium oxide, ...	23.11
Magnesium oxide, ...	2.52
Phosphoric acid, ...	30.59

Animal had been fed largely with roots; milk yielded its butter slowly.

Analysis of Onions.

Air dry without leaves—

	Per cent.
Moisture, at 100° C., ...	89.20
Dry matter, ...	10.80

Dry matter contained of—

	Per cent.
Nitrogen, ...	2.12
Sulphur, ...	.48
Ash constituents, ...	4.36

One hundred parts of ash contained—

	Per cent.
Potassium oxide, ...	38.51
Sodium oxide, ...	1.90
Calcium oxide, ...	8.20
Magnesium oxide, ...	3.65
Sequioxide of iron, ...	.58
Silicic acid, ...	3.33
Phosphoric acid, ...	15.80
Sulphuric acid, ...	Not determined.

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Analyses of Drainage Waters of Experimental Plats.

	Plats No.	Parts per Million.							Grains per Gallon.			
		Free Ammonia.	Albuminoid Ammonia.	Total Ammonia.	Nitrogen as Ammonia.	Nitric Acid.	Nitrogenous Nitrates.	Calcium Carbonate (Hardness).	Solids.	Potassium Oxide.	Phosphoric Acid.*	Clorine.
11 A. M.,	0	.13	.09	.22	.18	3.15	.70	27.3	7.5	.18	–	.4
2.30 P. M.,	0	.11	.06	.17	.14	–	–	16.9	5.	.15	–	.4
2.30 "	1	.08	.11	.19	.16	73.19	16.26	†	†	†	†	†
11 A. M.,	3	.01	.07	.08	.07	1.20	.27	28.6	4.5	.13	–	.5
2.30 P. M.,	3	.45	.06	.51	.42	.83	.19	19.5	2.5	.13	–	.3
2.30 "	5	.02	.07	.09	.07	–	–	23.4	2.5	.11	–	.3
2.30 "	7	.01	.10	.11	.09	.22	.05	27.3	4.5	.18	–	.3
2.30 "	9	.02	.09	.11	.09	.28	.06	23.4	3.5	.14	–	.4
2 "	11	.01	.10	.11	.09	.41	.09	22.1	4.	.09	–	.2
11 A. M.,	13	.01	.08	.09	.07	.78	.17	22.1	4.	.12	–	.3
2 P. M.,	13	.01	.10	.11	.09	.59	.13	20.8	3.8	.21	–	.3
2 "	15	.01	.07	.08	.07	.13	.03	26.	4.5	.04	–	.3
2 "	17	.01	.10	.11	.09	.22	.05	45.7	9.	.07	–	.3
2 "	19	.01	.12	.13	.11	.78	.17	41.6	9.	.31	–	.4
11 A. M.,	B	.01	.12	.13	.11	.69	.14	18.2	2.3	.07	–	.5
2 P. M.,	B	.01	.15	.16	.13	–	–	15.6	13.3	.04	–	.4
2.30 "	C	.01	.11	.12	.10	.32	.07	18.2	2.5	.03	–	.3

* Trace. † Not determined.

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IV. Valuation of Fertilizers and Fertilizer Analyses.

The valuation of commercial fertilizers is based on the market value of their essential constituents. The market reports of New York and Boston, aside from consultations with leading manufacturers of fertilizers, furnish us the necessary information.

The statements of trade values adopted in the reports are obtained by taking the average of New York and Boston wholesale quotations of the six months preceding March 1, 1883, and increasing them by 20 per cent. to cover expenses for storage, sales, etc.

The prices stated in connection with analyses of commercial fertilizers refer, therefore, to their cost per ton of 2,000 pounds, on board of car or boat.

Crude stock for the manufacture of fertilizers, and refuse material of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

The *mechanical condition* of any fertilizing material, simple or compound, deserves the most serious consideration of farmers when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizer, although equally pure, may differ from 50 to 100 per cent. in commercial value on account of mere difference in moisture.

As existing laws of the State for control of the trade in commercial fertilizers provides for the examination of licensed articles, the attention of the Station has been directed mainly towards the examination of agricultural chemicals, the crude stock for the manufacture of commer-

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cial fertilizers, and of prominent refuse materials from manufacturing industries and elsewhere.

The work has been carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

General experience in farm practice teaches that it is safer, for economical reasons, to use commercial fertilizers rather as supplements than as substitutes for barn-yard manures.

The advantages arising from the introduction of chemical and commercial manurial substances can only be secured to their full extent when applied with reference to actual local wants of the soil, and to special requirements of the crops under cultivation.

A large percentage of commercial manurial material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and diminish financial disappointment in consequence of their application.

TRADE VALUES ADOPTED FOR 1883.

	Cents per lb.
Nitrogen in nitrates,	20
Nitrogen in ammonia salts,	26
Nitrogen in Peruvian guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures,	23
Nitrogen in coarse or moist blood, meat, or tankage, in cotton-seed, linseed, and castor pumice,	18
Nitrogen in fine ground bone, horn, and wool dust,	17
Nitrogen in fine medium bone,	15
Nitrogen in medium bone,	14
Nitrogen in coarse medium bone,	13
Nitrogen in coarse bone, horn shavings, hair, and fish scrap,	11
Phosphoric acid, soluble in water,	11
Phosphoric acid, "reverted," and in Peruvian guano,	8
Phosphoric acid, insoluble, in fine bone, fish guano, and superphosphates,	6

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	Cents per lb.
Phosphoric acid, insoluble, in fine medium bone,	5½
Phosphoric acid, insoluble, in medium bone,	5
Phosphoric acid, insoluble, in coarse medium bone,	4½
Phosphoric acid, insoluble, in coarse bone, bone ash, and bone black,	4
Phosphoric acid, insoluble, in fine ground rock phosphate,	2.75
Potash, in high grade sulphate,	7
Potash, in low grade sulphate and kainite,	4¼
Potash, in muriate or potassium chloride,	4¼

V. Fertilizer Analyses.

Dry Ground Fish.

(Sent from South Hadley Falls, Mass.)

Moisture, at 100° C.,	10.38
Total phosphoric acid,	6.00
Soluble phosphoric acid, Reverted phosphoric acid,	2.82
Insoluble phosphoric acid,	3.18
Nitrogen,	6.13

Valuation per two thousand pounds, $36.53.

Castor Pumice.

(Collected of D. A. Horton, Northampton, Mass.)

Moisture, at 100 C.,	10.18
Total phosphoric acid,	2.13
Nitrogen (18 cents per pound),	5.69
Potassium oxide,	0.92

Valuation per two thousand pounds, $23.84.

1. Dry Fish, sent by Franklin Farmers' Club.
2. Dry Fish, sent by Milo L. Smith, Smith's Ferry, Mass.
3. Half-dry Dog Fish Pumice, sent on from Portsmouth, R. I.

	Pounds per Hundred.		
	1	2	3
Moisture, at 100° C.,	6.61	7.50	11.35
Total Phosphoric Acid,	6.17	7.67	5.85
Soluble " " Reverted, " "	2.40	2.32	.66 / 2.20
Insoluble, " "	3.77	5.35	2.99
Nitrogen,	8.47	9.36	6.96
Valuation per two thousand tons,	$47 32	$53 18	$40 58

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Nova Scotia Plaster (Gypsum.)

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	15.79
Calcium oxide,	34.29
Magnesium oxide,	0.36
Sulphuric acid,	47.14
Insoluble matter,	1.42
Carbonic acid,	Not determined.

This gypsum contained a few per cent. of calcium and magnesium carbonates, which not unfrequently are associated with it.

"Orchilla" Guano.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	11.05
Magnesium oxide,	4.13
Calcium oxide,	38.24
Phosphoric acid,	21.69
Insoluble matter,	0.17

The "Orchilla" guano belongs to a class of natural phosphates which are noted for their deficiency in organic and nitrogenous matter, as well as for their large percentage of carbonate of lime. The above described sample contained 47.39 per cent. of bone phosphate, and 22.39 per cent. of carbonate of lime. The presence of so large a percentage of the latter compound renders this material, from an economical standpoint, unsuitable for the manufacturers of superphosphate of lime. The natural pulverent condition of the ommercial article has favored its introduction into agricultural practice. Very satisfactory results are reported from its application in case of moist pastures and meadows, and of turfy soils. Upon a dry soil and in a dry season its action can be but slow. The safest way to secure an economical return seems to be a direct introduction in the daily product of stable manure, on account of the beneficial action of the fermenting animal excretions on the disintegration of the guano, and thus an increased solubility of its bone phosphate. Four cents per pound for phosphoric acid might be considered a safe investment. At that rate of valuation the above article would be worth $18 per ton of two thousand pounds.

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Fish Pumice.

(Collected of H. L. Phelps, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	44.41
Total phosphoric acid,	5.85
Soluble phosphoric acid,	1.57
Reverted phosphoric acid,	0.62
Insoluble phosphoric acid,	3.62
Nitrogen,	5.27

Valuation per two thousand pounds, $33.02

CANADA WOOD ASHES.

1. Sent from Sunderland, Mass.
2. Sent from Sunderland, Mass.
3. Sent from North Amherst, Mass.
4. Collected in Railroad Depot, Amherst, Mass.
5. Sent on from North Amherst, Mass.
6. Collected of D. A. Horton, Northampton, Mass.
7. White Ash, sent on from South Deerfield, Mass.

	Pounds per Hundred.						
	1	2	3	4	5	6	7
Moisture, at 100° C.,	24.50	16.66	18.70	9.30	8.40	16.70	6.62
Calcium Oxide,	33.19	32.25	30.60	34.91	39.71	35.26	50.89
Potassium Oxide,	4.77	4.97	4.61	6.50	4.96	5.55	5.23
Phosphoric Acid,	1.49	1.66	1.10	.78	.80	2.28	1.29
Insoluble Matter,	8.50	10.45	11.06	9.30	6.70	4.90	4.87

Samples 1, 2, 3, 4, 5, 6 represent the average quality of Canada wood ashes sold in our section of the Connecticut valley, at from 33 to 35 cents per bushel. Sample 7 was of an exceptional light color, and contained a larger per cent. of lime, yet compared well otherwise in composition with the others. The increasing importation of Canada ashes into various parts of the States renders it advisable to insist hereafter upon guaranteed analyses as the basis of commercial transactions.

The universal high opinion of wood ashes as a fertilizer does not depend merely upon a fair percentage of potash, but also on the presence of more or less of *all the various mineral elements essential to the growth of plants.*

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Wood ashes, like barn-yard manure, on account of their compound character, meet, to some extent at least, not only known but unknown deficiencies in valuable soil constituents. The thorough mixture of their various constituents has, no doubt, a beneficial influence on their action.

8. Light-colored unleached ashes, sent by Secretary of South Deerfield Farmers Club. One bushel weighed forty-four pounds, and half pound of coarse material was removed before taking the sample for analysis.

9. Dark unleached ashes, sent by Secretary of South Deerfield Farmers' Club. One bushel weighed forty-six pounds, and two and a half pounds of coarse material was removed before taking the sample for analysis.

10. Dark unleached ashes, sent by Secretary of South Deerfield Farmers' Club. One bushel weighed forty-one pounds, and five pounds of coarse material were removed before taking the sample.

11. Collected on board cars at railroad depot, South Deerfield, Mass.

12. Collected on board cars at railroad depot, South Deerfield, Mass.

13. Collected of Mr. Almon Cowles, on board of cars, at North Amherst, Mass.

	Pounds per Hundred.					
	8		10	11	12	13
Moisture, at 100 C., . .	0.70	16.98	10.28	8.33	1.03	10.01
Calcium Oxide, . . .	50.51	36.11	32.83	45.00	50.02	35.67
Potassium Oxide, . . .	7.38	4.90	6.10	5.91	6.94	7.19
Phosphoric Acid, . . .	0.51	1.41	1.59	0.74	0.29	1 28
Insoluble Matter, . . .	2.10	8.05	13.65	3.88	2.28	6.27

Nitrate of Soda.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C., ...	1.25
Nitrogen, ...	15.57
Insoluble matter, ...	0.45

Valuation per two thousand pounds, $62.28

Muriate of Potash.

(Collected of George P. Smith, Sunderland, Mass.)

	Per cent.
Moisture, at 100° C., ...	2.85
Potassium oxide, .	50.59
Sodium oxide, ...	8.40
Magnesium oxide, ...	trace.
Sulphuric acid, ...	trace.
Insoluble matter, ...	1.50

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(2. Collected of E. T. Sabin, East Amherst, Mass.)

	Per cent
Moisture, at 100° C.,	2.89
Potassium oxide,	50.05
Sodium oxide,	8 30
Magnesium oxide,	0.60
Sulphuric acid,	0.28
Insoluble matter,	0 15

Valuation per two thousand pounds, $42.54.

This form of "German Potash Salts" has thus far proved a very reliable source of potassa for general agricultural purposes; an extensive application has caused, of late, some advance in its cost, as compared with previous years.

Ammonium Sulphate.

(Collected of Geo. P. Smith, Sunderland, Mass.)

	Per cent.
Moisture, at 100° C.,	0.23
Ammonia (equivalent to nitrogen 20.4),	24.80
Sulphuric acid,	61.60
Insoluble matter,	0.05

Valuation per two thousand pounds, $106.08.

Peruvian Guano.

(Collected of D. A. Horton, Northampton, Mass.)

	Per cent.
Moisture, at 100° C.,	14.00
Total phosphoric acid,	20.60
Soluble phosphoric acid,	3.10
Reverted phosphoric acid,	1.55
Insoluble phosphoric acid,	15.95
Potassium oxide,	1.14
Nitrogen in organic matter,	1.40
Nitrogen in ammonia salts,	3.04

Valuation per two thousand pounds, $51.66.

Tankage.

(Sent from Chicago, Ill.)

	Per cent.
Moisture, at 100° C.,	6.10
Total phosphoric acid,	12.32
Soluble phosphoric acid,	0.27

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	Per cent.
Reverted phosphoric acid,	3.25
Insoluble phosphoric acid,	8.79
Nitrogen,	6.57
Insoluble matter,	0.77

Florida Marl.

(Sent from Boston, Mass.)

	Per cent.
Moisture, at 100° C.	0.60
Calcium oxide,	41.75
Magnesium oxide,	1.03
Ferric oxide,	0.36
Phosphoric acid,	2.72
Insoluble matter,	21.95

Sponge Refuse.

(Sent from Albany, N. Y.)

	Per cent.
Moisture, at 100° C.,	7.25
Nitrogen,	2.43
Ferric oxide,	0.17
Calcium oxide,	3.94
Magnesium oxide,	1.27
Phosphoric acid,	3.19
Insoluble matter,	39.05

Bones.

(Pure Dissolved Raw Bones. Sent from Amherst, Mass.)

	Per cent.
Moisture, at 100° C.,	10.23
Total phosphoric acid,	16.03
Soluble phosphoric acid,	7.76
Reverted phosphoric acid,	3.83
Insoluble phosphoric acid,	4.44
Nitrogen,	2.64

Valuation per two thousand pounds, $40.67.

Fine Ground Raw Bone.

(Sent on from Worcester, Mass.)

	Per cent.
Moisture, at 100° C.,	4.63
Total phosphoric acid,	22.41
Nitrogen,	3.69

Valuation per two thousand pounds, $43.86.

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1. Bone Fertilizers. Sent by John Sanborn, Lawrence, Mass.
2. Pure Fine Ground Bones. Sent from Amherst, Mass.

	Pounds per Hundred.	
	1	2
Moisture, at 100° C.,	4.25	5.27
Total phosphoric acid,	24.06	23.18
Soluble phosphoric acid,	0.76	0.46
Reverted phosphoric acid,	3.66	3.62
Insoluble phosphoric acid,	19.64	19.05
Nitrogen,	2.88	3.73
Valuation per 2,000 lbs.,	$44 35	$46 82

"*Americo*," *A 1*, *Peruvian Guano.*

(Sent by Joseph C. Cozzen, Swansea, Mass.)

	Per cent.
Moisture, at 100° C.,	8.35
Total phosphoric acid,	10.03
Soluble phosphoric acid,	2.99
Reverted phosphoric acid,	1.72
Insoluble phosphoric acid,	5.32
Potassium oxide,	3.84
Nitrogen,	5.62

Valuation per two thousand pounds, $44.82.

PEAT.

1. Sent from Harwich, Barnstable Co., Mass.
2. Sent from Hudson, Worcester Co., Mass.
3. Sent from Holyoke, Hampden Co., Mass.

	Pounds per Hundred.		
	1	2	3
Moisture, at 100° C.,	78.26	33.61	54.28
Dry Matter,	21.74	66.39	45.72
Ash constituents in Dry Matter,	1.31	4.54	33.72
Nitrogen in wet Peat,	0.41	1.40	0.43
Nitrogen in perfectly dry Peat,	1.89	2.11	0.94

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The difference in the composition of samples 1 and 2 is mainly due to their different state of moisture. Both are fair specimens of their kind. The low percentage of nitrogen in sample 3 is caused by an exceptionally large admixture of soil. Wherever the entire deposit shows a similar amount of earthy admixture, a direct cultivation, after draining, suggests itself as worth trying.

Crude Kieserit,

(Crude Sulphate of Magnesia. Of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C,	31.90
Calcium oxide,	2.60
Magnesium oxide,	13 50
Sulphuric acid,	29.10
Insoluble matter,	5.00
Magnesium in form of chloride,	0.60
Magnesium in form of sulphate,	38.70

Valuation per two thousand pounds, from $8 to $10.

The "Kieserit" occurs among the salines of the salt mines at Stassfurt in Germany, which of late have acquired a particular importance as leading resources of potash compounds for agricultural purposes. Although it forms distinct layers of considerable thickness, it is quite frequently found more or less saturated with a solution of magnesium chloride when removed from the mines. Well-established experimental observations regarding the injurious influences of the latter compound on the healthy growth of roots render its presence objectionable, and consequently its removal, as far as practicable, desirable, whenever kieserit shall be used for agricultural purposes.

The removal of any objectionable percentage of magnesium chloride is usually accomplished by subjecting the crude material to a moderate calcination. The moisture present largely decomposes, at a high temperature, the magnesium chloride into hydrochloric acid, which escapes, and into magnesium oxide, which remains behind. We find, for this reason, the calcined and uncalcined kieserit in our markets. The former contains, for obvious reasons, a larger percentage of magnesia than the latter; yet it is usually less soluble in water. Both kinds ought to be well ground to render a proper distribution possible.

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The kieserit, on account of a greater solubility in water, exceeds in efficiency the sulphate of lime or gypsum, as an absorber of ammonia, in manure cellars, in stables, and upon the compost heap.

Its well-known beneficial influence on a speedy diffusion of potash compounds throughout a deeper layer of soil, as well as its reputed favorable action on leaf and stem growth, are of sufficient importance to encourage experiments on the part of farmers, and in particular of gardeners and fruit growers, to test its influence. The prominence of the magnesia among the mineral constituents of many of our grain crops and fruits, leaves scarcely a doubt about its importance in the vegetable economy of many of our cultivated plants.

Potash Magnesia Sulphate.

(Collected of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C.,	4.90
Calcium oxide,	1.15
Magnesium oxide,	11.30
Potassium oxide,	24.94
Sodium oxide,	2.09
Sulphuric acid,	46.99
Insoluble matter,	0.54

Valuation per two thousand pounds, $34.92.

The above compound belongs to a series of salines which some ten years ago, under the name of "German Potash Salts," or "Stassfurt Salines," were introduced into our agricultural industry for manurial purposes.

Its peculiarity consists in the combination of a large amount of potassium sulphate, from 46 to 47 per cent., with a remarkable quantity of magnesium sulphate, from 33 to 34 per cent.

The magnesium sulphate stands foremost among substances noted for their quality to counteract the well-known great retentive power of most soils for potassa.

This circumstance renders the potash-magnesia sulphate a very valuable material for the cultivation of deep-rooting plants, in case of an exhaustion of potassa in the subsoil.

The potash-magnesia sulphate, as well as the "Douglass Muriate of Potash," occupy a peculiar position among our

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recently introduced potash resources for manurial purposes. The former has proved the preferable compound where the presence of large quantities of chlorides is known to affect seriously the quality of the vegetable growth, as in the case of tobacco, etc.; whilst the latter recommends itself, on account of from 70 to 75 per cent. of muriate of potash, in presence of from 15 to 20 per cent. of sulphate of magnesia, for deep-rooting forage plants.

A detailed discussion of the character and special fitness of the various brands of German potash plants for agricultural purposes can be found in the annual report of the Secretary of the Mass. State Board of Agriculture for 1874.

Dissolved Boneblack.

(Of Bowker Fertilizer Co., Boston, Mass.)

	Per cent.
Moisture, at 100° C.,	20.78
Total phosphoric acid,	15.66
Soluble phosphoric acid,	12.76
Insoluble phosphoric acid,	2.90

Valuation per two thousand pounds, $31.55.

Ashes from Detroit.

(Sent by John Lane, Esq., of East Bridgewater, Mass.)

	Per cent.
Moisture, at 100° C.,	6.39
Calcium oxide,	34.15
Potassium oxide,	1.00
Phosphoric acid,	2.05
Magnesium oxide,	3.72
Insoluble matter,	22.10

The ash had evidently been leached before it entered the market.

Turf.

(Sent on by Horace Graves, Amherst, Mass.)

1. Turf from upper layer, consisting largely of leaves, roots and mosses,—brown colored and fibrous.

2. Turf from lower layer, consisting of a brown peat-like mass, taken from four feet below the surface, and exposed to the air one year.

	1	2
Moisture, at 100° C.,	25.58	13.00
Organic and volatile matter,	96.72	90.57
Ash constituents,	3.28	9.43
Nitrogen (in wet peat),	1.91	1.97

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The upper layer may be used advantageously as bedding and as an absorber of liquid manure; the lower layer ought to be composted with lime or ashes before it is incorporated in the soil. Both samples are of a good quality.

Ash of Bogs.

(Sent by J. B. Wheeler, Bolton, Mass.)

	Per cent.
Moisture, at 100° C.,	5.05
Calcium oxide,	3.09
Magnesium oxide,	1.13
Potassium oxide,	0.16
Phosphoric acid,	0.93
Insoluble matter,	70.92

The ashes were obtained from the burning of the surface growth of a swamp meadow lately in part underdrained. Bogs, tussocks, and a few inches thickness of the turf, furnished the ash. The dried-up condition of the vegetable matter explains the presence of but a small quantity of potash. The ash may prove beneficial upon adjoining grass lands.

Tobacco Stems.

(Sent by E. S. Warner, Hatfield, Mass.)

	Per cent.
Moisture, at 100° C.,	8.95
Dry matter,	91.05
Nitrogen in dry matter,	2.69

One hundred parts contained: —

	Per cent.
Potassium oxide,	6.21
Sodium oxide,	0.68
Calcium oxide,	4.76
Magnesium oxide,	1.14
Phosphoric acid,	0.87
Silica, sulphuric acid, etc.,	Not determined.

Valuation per ton of two thousand pounds: —

3.80 pounds nitrogen, at 18 cents,	$9 68
124.20 pounds potassium oxide, at 4¼ cents,	5 28
17.40 pounds phosphoric acid, at 6 cents,	1 04
	$16 00

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The ash of the tobacco plant usually varies less in regard to absolute quantity than to the relative proportion of its essential elementary constituents. Potash is known to vary as high as 50 per cent. in consequence of modes of cultivation and variety of soil, independent of the variety of plant. As it is claimed by good authority that an increase or a decrease of the potash in the ash of the tobacco stands in a definite relation to certain qualities of the latter, it is proposed to discuss this question more in detail hereafter.

Superphosphate.

(Of Earle & Co., Providence, R. I. Sent from Dennisport, Mass.)

	Per cent.
Moisture, at 100° C.,	9.48
Total phosphoric acid,	15 08
Soluble phosphoric acid,	7.88
Reverted phosphoric acid,	0.69
Insoluble phosphoric acid,	6.51
Potassium oxide,	2.34
Nitrogen,	2.91

Valuation per two thousand pounds, $41.64.

Haynes Fertilizer.

(Of Mr. Haynes, Bolton, Mass. Sent from Lancaster, Mass.)

	Per cent.
Moisture, at 100° C.,	17.63
Total phosphoric acid,	10.14
Soluble phosphoric acid,	5.89
Reverted phosphoric acid,	0.87
Insoluble phosphoric acid,	3.38
Potassium oxide,	5.70
Nitrogen (organic),	2.72
Nitrogen (ammonia),	0.71
Nitrogen (nitrates),	0.60

Valuation per two thousand pounds, $41.85.

VI. Chemistry in Fruit Culture.

The subject of this discussion was the outgrowth of a series of field experiments with sugar beets upon the college farm (1870–75). The beneficial influence of certain articles of plant-food on the saccharine qualities and general character of the beet-root which had been noticed in that connection, suggested the extension of the observations to fruits.

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The scarcity of systematic investigations concerning the mineral constituents of fruit-bearing plants and of fruits, rendered it necessary to ascertain their ash constituents under definite soil conditions, and to study the effect of special articles of plant-food on the mineral constituents of the growth produced by their aid. It was assumed that in case some definite change in the relative proportions of the mineral constituents was noticed, a safer basis could be obtained for distinguishing between the influence of season, location, the general character of the soil, etc., and the influence of the amount and the kind of the available plant-food applied. A portion of land in charge of the horticultural department of the Massachusetts Agricultural College has been set apart for that purpose since 1874.

Wild and cultivated varieties of grape-vines were the first plants chosen for the investigation.

The experiments have been extended in the course of time to strawberries, currants, blackberries, raspberries, apples, pears, cherries and peaches.

The results obtained with grape-vines and strawberries, which have been published in previous reports of the College (1875–76), in the reports of the State Board of Agriculture (1879–80), and in the Massachusetts Ploughman (1877–78), and elsewhere, have established the fact that fruit-bearing plants respond decidedly, as far as their composition is concerned, to the application of special manures.

The currants, raspberries and blackberries raised during the past year are at present under examination, and the fruits of most of the trees will be ready for examination a year or two hence.

The appended report of Prof. Maynard refers to the present condition of these experimental fruit plats, five in number. His statement regarding the serious influence of manuring peach trees in particular, without reference to wants, deserves attention.

VII. Peaches and Peach Yellows.

The interest manifested by frequent inquiries regarding the management of diseased peach trees on the College grounds, has to serve as an excuse for introducing the sub-

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ject in the present report, although little that is new and of general interest can be added beyond the fact that the restored trees are healthy and bearing, and that new trees planted in the places where diseased trees have been removed,* have been bearing healthy fruit during the past season. The subsequent observations were made on peach trees planted in 1870 in the orchard of the College, and not on the young trees upon the experimental plats of the Station.

The experiments began in the fall of 1877, when my attention was first called to the appearance of the disease in the College orchard, on the top of a knoll of light soil. The general appearance of the trees at the first stage of the disease suggested to my mind the idea that an abnormal condition of the soil might be the first cause of its development. This circumstance could be due either to a more or less general exhaustion, or to the absence of only one or the other essential elements of plant-food; or finally, to the presence of some injurious substances which might have accumulated in the soil from some cause or other in the course of time.

The gradual disappearance of the green color (chlorophyl) in the leaves, beginning at the outer termination of the young branches, — which are the most active parts of the plants for the formation of new vegetable matter, — seemed to point towards a local interference with the normal cellular functions, a natural consequence of an abnormal sap. I felt inclined to consider the fungus which, in its gradual development, disfigures the diseased parts of the tree, a secondary cause of their ultimate condition. My observations of later years with grape-vines and currants in particular, have tended to confirm in my mind the view that our troubles with parasitic growth on plants are in many instances due to an abnormal condition of the soil, rather than to a particular condition of the atmosphere. I have repeatedly noticed that plants suffered seriously from mildew and blight upon unfertilized and exhausted lands, when upon adjoining fertilized plats neither could be noticed. Diseases of plants are known to originate from internal and external causes,

* See Prof. Maynard's appended Report.

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Internal troubles may be increased by external influences and *vice versa*. As the gradual change of the new foliage of the affected trees from a bright green to a white or bleached appearance, had to be ascribed to a suppressed formation of the chlorophyl, my attention was quite naturally directed to earlier observations of a similar character. Some experiments by Nobbe, Schroeder and Erdmann (Chemnitz, 1871), had demonstrated the fact that the formation of the chlorophyl — the substance causing the green color of the plants — could be controlled by the application of certain forms of potassa, engaged my particular interest. Their observations were made on rye and buckwheat. They had raised both kinds of plants under well-defined circumstances, supplying to one set the potash in the form of sulphate of potassium, and the other in the form of chloride of potassium (muriate of potash).

The plants raised with the aid of the chloride of potassium were of a vigorous growth, with a rich dark-green colored foliage, and yielded a good crop of grain. Those raised by the aid of the sulphate of potassa turned prematurely yellow and failed gradually.

An examination of the diseased lots of plants showed an excessive accumulation of starch in the cellular tissue, whilst but little chlorophyl was noticed. On the strength of these considerations, I began a systematic investigation of the disease by an analytical chemical examination of various parts of the peach tree in different stages of growth. The results of these analyses are stated below in chronological order.

A limited number of trees affected by the yellows were also selected for the experiment with special manures. The ground around the trees was treated with superphosphates deficient in nitrogen (acid rock phosphate or soluble bone-black), and each tree (about eight years old) received from two to three pounds of muriate of potash, which was sown broadcast over a surface extending about eight feet from the trunk of the tree. None of these chemicals were brought into close contact with the trees, except when spread over a heavy mulch, to prevent serious reactions on the roots. The diseased branches were cut back at the same time to the healthy wood.

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The practical management of these operations was, from the beginning to the present time, under the personal supervision of Prof. Maynard.

The application of phosphoric acid and of muriate of potash was repeated the succeeding spring. The new growth of branches and leaves showed a decided improvement both in vigor and color.

The trees have been cut back for several years, and they have since repeatedly produced healthy fruit.

Analyses of Parts of the Peach Tree.

Branches in Blossom from sound Crawford Peach Tree.

(Collected in May, 1877.)

Moisture lost at 100° C.,	56.77 to 59.74
Dry matter,	43.23 to 40.26
Ash in dry matter,	– to 4.63
Nitrogen in dry matter,	2.16 to 2.09

A.—Healthy Early York Peach.

(Nearly ripe, but not mellow. Collected August, 1877.)

Moisture lost at 100° C.,	86.61 to 88.00
Dry matter (entire fruit),	13.39 to 12.00
Dry matter in pulp,	10.94 to 10.98
Specific gravity of juice at 25° C.,	1.0375 to 1.04
Grape sugar in juice,	1.35 to 1.38
Cane sugar in juice,	4.12 to not det.

One hundred cubic cent. of juice neutralized from 40 5 to 44.0 cubic cent. of carbonate of soda solution (containing 1 part in 100).

B.—Healthy Early York Peach.

(Very ripe and mellow; tested three days after picking. Collected August, 1877.)

Lost in weight within three days,	5.48
Specific gravity of juice at 25° C.,	1.045
Grape sugar in juice,	1.92
Cane sugar in juice,	6.09

One hundred cubic cent. of juice neutralized 45 cubic cent. of soda solution (containing 1 part in 100). The whole weight of the peach tested was 49.32 grammes; stone weighed 3.71 grammes; ash of entire fruit, 0.2862, including carbonic acid.

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*A. — Healthy Early Crawford Peach.**

(Nearly ripe, but not mellow. Collected September, 1877.)

Moisture lost at 100° C.,	88.120
Dry matter in pulp,	11.880
Specific gravity of juice at 22° C.,	1.045
Grape sugar in juice,	1.670
Cane sugar in juice,	5.920

One hundred cubic cent. of juice neutralized 64 cubic cent. standard soda solution.

B. — Healthy Early Crawford Peach.

(Nearly ripe, but not mellow. Collected in September, 1877, wrapped in paper, and kept in a drawer for ten days. It turned very ripe and mellow, and had lost 9.50 of its weight.)

Specific gravity of juice at 18° C.,	1.050
Grape sugar in juice,	2.19
Cane sugar in juice,	7.02

One hundred cubic cent. of juice neutralized 85.6 of soda solution.

C. — Healthy Early Crawford Peach.

(Picked from the tree when turning mellow, and tested without delay, September, 1877.)

Weight of entire fruit, ... 118.06 grammes.

	Per cent.
Moisture lost at 100° C.,	88.660
Dry matter in pulp,	11.360
Specific gravity of juice at 18 C.,	1.055
Grape sugar in juice,	1.700
Cane sugar in juice,	8.940
Total ash of entire fruit, including carbonic acid,	0.344

One hundred cubic cent. of juice neutralized 76 cubic cent. of soda solution.

Ash Analyses of Crawford's Early Peach.

(Entire fruit taken from healthy and diseased trees in the same orchard. To render the differences in composition more prominent, only carefully determined constituents are reported, excluding soda, silica, etc., from the calculation.)

	Healthy Fruit. Crawford's Early Peach.	Diseased Fruit. Crawford's Early Peach.
Ferric oxide,	0.58 per ct.	0.46 per ct.
Calcium oxide (lime),	2.64 "	4.68 "
Magnesium oxide,	6.29 "	5.49 "
Phosphoric acid,	16.03 "	18.07 "
Potassium oxide,	74.46 "	71.30 "
	"	"
	100.00 "	100.00 "

* All samples tested taken from the same tree.

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Although the disease was in its first stage, the results show a marked difference in regard to the relative proportion of the mineral constituents of the healthy fruit, as compared with that from the diseased tree or the prematurely ripened fruit. These results seemed to prove the correctness of my views regarding the first cause of the disease.

Feeling, however, not satisfied with an explanation based on a presumed analogy of circumstances, I invited Prof. Penhallow, in the fall of 1880, to join me in the investigation by making some microscopic observations for the purpose of establishing, if possible, more clearly the relation of the fungus to the disease.

The questions proposed to him may be summed up as follows: —

1. Is there any abnormal accumulation of starch in the diseased wood, as compared with a healthy wood? 2. Does the wood of the restored tree regain again the general appearance of that of the healthy tree? 3. What becomes of the fungus in case of a diseased tree being restored to health? These questions were to be answered by an examination of a lot of branches taken from healthy, diseased and to-health-restored trees. The three samples of branches of the peach trees, from which the previously stated specimens for microscopic observation had been selected, were each carefully examined, and the ashes subjected to a careful analysis. The branches were secured in the presence of Prof. Penhallow, Nov. 11, 1881.

Their analysis was carried on by me, and repeated under my immediate supervision by an efficient assistant.

I. Analysis of the ashes obtained from the branches of a diseased Early Crawford Peach tree.

Ferric oxide,	1.44590
Calcium oxide,	64.22920
Magnesium oxide,	10.28270
Potassium oxide,	15.67516
Phosphoric acid,	8.36690

II. Analysis of the ashes obtained from the branches of a peach tree which had been affected in previous years by the yellows, and had been restored again to health in consequence of the treatment described in preceding pages.

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Ferric oxide,	0.5213
Calcium oxide,	54.5136
Magnesium oxide,	7.5788
Potassium oxide,	26.0129
Phosphoric acid,	11.3732

The differences in the composition of Ashes I. and II. are in the same direction as noticed in the ashes of healthy and diseased fruits, of the same variety of peaches.

Prof. Penhallow's microscopic observations are stated by him in the following summary: —

1. Healthy wood shows comparatively little stored starch; but fungous growth is present in the outer layers of the bark.

2. Diseased wood shows an abnormally small development of the cells, and the invariable presence of large quantities of starch; also an abundance of fungous growth.

3. Diseased leaves show the presence of fungous growth, discoloration and cells filled with starch.

4. The fungus appears first on the surface of the trunk or branches, and thence enters the woody structure, when the conditions are favorable.

5. There is little or no difference between the tissues and cell contents before and after the leaves fall.

6. While fungus is abundant on fully diseased trees, it is also to be found on trees which, *once diseased, had been restored to a condition of vigorous health.**

These results apparently confirm the views entertained when planning the investigation, and tend to show that an interior disorder, caused by an abnormal composition of the sap — as far as its mineral constituents are concerned — precedes the serious development of the fungus.

Our late advice to fruit-growers has been based on the teachings of the experiments previously described.

We recommend a careful watching of the peach orchard, to notice the disease in its first stages if possible.

The first signs are to be met by an immediate application of from two to three pounds of muriate of potash to each

* More detailed investigations of Prof. Penhallow have been recently published by him, in connection with the publications of Houghton Farm.

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tree, within a radius of from six to eight feet from the trunk. This dressing is best applied upon a heavy mulch of grass or cut straw. The cutting back of the diseased branches to the healthy wood ought to be carried out as general considerations recommend. A repetition of the same treatment for one or two seasons has been usually sufficient to correct the new growth of the tree, provided the disease has not gone too far before the remedies were applied.

Besides the special treatment of the affected tree — as previously described — we have recommended as a general fertilizer for a peach orchard the following composition, which has served us well in past years: Broadcast per acre 400 to 450 lbs. acid bone phosphate, containing from 11 to 12 per cent. of soluble phosphoric acid; 125 to 150 lbs. of muriate of potash, and 75 to 100 lbs. of crude sulphate of magnesia (Kieserit).

The latter compound is added for the purpose of assisting in the diffusion of the potash, and securing available magnesia.

This fertilizer is best applied partly late in the fall and partly in the early succeeding spring. The fertilizer ought to be applied with a view to supply existing wants, rather than to promote excessive growth of wood.

C. A. GOESSMANN,
Chemist.

Assistants —

JOSEPH B. LINDSEY, Class '83.
CHARLES H. PRESTON, Class '83.
H. J. WHEELER, Class '83.

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SECOND ANNUAL REPORT

OF THE

STATE

AGRICULTURAL EXPERIMENT STATION,

AT

AMHERST, MASS.

1884.

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MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION.
AT AMHERST, MASS.

BOARD OF CONTROL, 1884.

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* Messrs. Preston and Lindsey have since accepted more lucrative positions elsewhere.

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BOSTON, MASS., Jan. 31, 1885.

To the Massachusetts State Board of Agriculture.

GENTLEMEN: — I beg to enclose the annual reports of the Director and Treasurer of the experimental station at Amherst, for the year ending 1884.

Respectfully submitted.

O. B. HADWEN,
Secretary.

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SECOND ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The work carried on at the experiment station during the past year, has been, as far as practicable, in conformity with the plans presented for your consideration at the first quarterly meeting of the Board.

The farm-house, originally designed for office and working rooms, has been changed into a dwelling-house for the farmer of the station, retaining one room for keeping the farm records. The grounds around the farm buildings have been rendered attractive by improvements in the roads and otherwise.

An experienced practical farmer, for several years previous tried in the service of the college, has been engaged since the first of April, 1884, to carry out, as directed, the practical work in the field and barn of the station.

Part of the stables for keeping animals for feeding experiments, have been fitted up, at an early date of the season, to meet the temporary requirements in that direction. Three feeding experiments — two with milch cows and one with pigs — are described within this report. Others are in progress, and will be reported, as soon as finished, in our periodical bulletins.

The work in the field has been in several directions, and to the full extent of the present resources. The underdrained plats described in the previous report, have been again planted with corn without manuring, to prepare them for special trials with various manurial substances, in connec-

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tion with a careful examination of the drainage waters passing out.

Arrangements have been made to study the effect of commercial fertilizers, — compounded at the station, — on the quantity and the quality of the crops grown by their aid, as compared, in both directions, with the growth of the same plants upon unfertilized lands of a corresponding soil. Four standard grasses, two millets and one reputed variety of corn, are included in that trial. The mode of operation and the first year's results form part of the enclosed report.

Some field observations have been instituted to study the specific action of different forms of potassa — muriate and sulphate — on the character of the crops raised under their influence. Besides various kinds of small fruits, fruit trees, etc., a prominent crop, the potato, has been selected for that purpose.

Six reputed forage crops, vetch, serradilla, white lupine, horse bean, common lucerne, and sand lucerne, belonging to the valuable family of farm plants of which the clover is a conspicuous representative — *Leguminosæ* — have been planted with a view to study their adaptability to our climate, and eventually to increase our chances for raising a greater variety of nutritious fodder for farm live stock.

Many of these experiments will require years of close observation before reliable deductions can be safely drawn from the results obtained from them, — features more or less common to all field experiments, — a good argument in favor of an early beginning of the work.

The products of the garden and the orchard have received their share of attention. The work undertaken in these important branches of agricultural industry proposes to ascertain the quality, and the relative and absolute quantity, of mineral constituents of prominent fruits and garden crops. A more reliable information in that direction will secure for us a careful basis for special fertilization, and thereby a more rational mode of their cultivation. The results presented in this connection have been greatly increased by a series of valuable contributions of Prof. S. T. Maynard: observations in regard to insects injurious to the apple; notes upon insects injurious to farm and garden crops; on the causes of

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certain diseases of grasses; observations regarding the vitality of the seeds of various weeds; vitality of seeds as affected by age, and the destruction of peach buds by cold. His personal report forms the first chapter of this report.

The various crops raised in connection with the previously enumerated field experiments have, in most instances, been subjected to a chemical analysis, for the purpose of obtaining additional information for a judicious decision regarding their true character.

Experiments are under way with ensilaging fodder corn and pearl millet. A description of the results will be published as soon as the silo shall be opened for examination.

The work in the chemical labratory has been in various directions, and quite extensive, considering circumstances. Aside from the numerous analytical examinations in connection with the experiments in stock-feeding and in the field, a considerable number of fodder plants have been chemically tested for general information.

A large number of agricultural chemicals and other commercial manurial matter, not included in the control of the laws for the sale of licensed fertilizers, besides refuse material from various manufacturing industries throughout the State, have been analyzed at the request of farmer's clubs and farmers, in most instances at the special solicitation of the officers of the societies.

Many analyses of milk have been made, for the purpose of studying the influence of various kinds of feed on its quality.

Considerable attention has been given to the testing of drinking waters sent on from various localities in the State. The importance of attending more systematically, on farms, to the supply of a good water for drinking, has been discussed in a subsequent communication.

The calls upon the station for testing material of various descriptions, and interesting to farmers, have been quite frequently beyond its temporary resources, and had to be deferred at times, contrary to the best interest of the applicants.

Arrangements have been perfected of late to keep a complete weather record, and to assist the United States Signal

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Service in the dissemination of useful knowledge. A set of ordinary meteorological instruments, uniform with those in use at Washington, have been placed in a suitably constructed and advantageously located little wooden structure, in the vicinity of the farm-house. As the record kept during past years upon the grounds has been incomplete, for want of suitable instruments, we have availed ourselves of the kindness of Miss S. C. Snell of Amherst, and insert a copy of her last year's weather record. In addition to this particular favor she has kindly consented to a copying of the entire elaborated weather record of her distinguished father, the late Prof. E. S. Snell of Amherst, Mass., which extended over nearly fifty years, and is one of the most valuable weather records within the United States. The copy of this record will be made with particular reference to the months of April and May and August and September, to meet the special interests of the farmers.

A consideration of the above enumeration of the work undertaken at the station during the past year, may show that it has been the aim to meet, as far as practicable, the purpose for which this institution has been established. The various directions in which experimental inquiries, thus far, have been inaugurated, it will be conceded, are of first importance, and open an extensive field for investigation. Some experiments promise valuable results at an early date, and others necessitate years of systematic observation; none of them can be neglected for any length of time without serious consquences to our farm industry. The work thus far outlined represents at best but a limited selection of subjects, regarding which better information is essential for a successful advancement of the best interest of our farmers.

To carry on any investigation in the field, the barn and the laboratory requires time, skill and pecuniary means. Experience teaches that first expenses for inaugurating a series of experiments are quite frequently comparatively small, and the necessity for skilful assistants less imperative, than when the work becomes more intricate in its advance, and calls for exceptional accommodations, more complicated and expensive apparatus, and a more liberal supply of skilled assistance.

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The State experiment station furnishes no exception in this direction. For over two years the work has been carried on within the means furnished by the State, without incurring serious responsibility from a financial standpoint. The most rigid economy only has enabled the managers to meet, to some extent, the emergency of the case. This, even, has not been possible without serious detriment to the successful working of the station, and thus, ultimately, the best interests of the farming community. The requirements for carrying out the present system of management has of late reached a point where more means are indispensable in the interest of success. A short description of present conditions cannot fail to support my previous statement. The stalls for feeding are in some instances in an unfinished condition, and in the majority of cases only finished to serve temporary purposes. There are no means to secure animals most desirable for experiment, beyond a choice from the limited stock of the college.

The fields rented from the college are only properly treated as far as the experimental plats are concerned; the remaining larger portion of the area, consisting of exhausted grass land, had to be left in that undesirable condition, for want of means to render it more productive. Arrangements for producing steam, for carrying on experiments with the products of the dairy, and for keeping ice, are wanting. The same is the case with reference to suitable rooms for experiments to study the specific action of various forms of plant food under well defined conditions, for hot-beds and sheds. Many of the farm tools have still to be borrowed of the college, nor has the station thus far been able to compensate the college for the use of house, barn and fields.

The chemical work called for has long outgrown the resources of the present laboratory. Efficient chemical investigation needs better and more extensive rooms, and a larger and more selected supply of apparatus. Above all, more privacy is desirable for important chemical and other scientific work, than a part of a much frequented college building, constructed for a different purpose, can furnish. A new building, designed with a view to meet the present and still

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growing special wants of the station in the above-mentioned direction, will prove ultimately the best economy.

The scientific assistance has thus far been supplied, in a great measure, by recent graduates of the college, at rates insufficient to retain their services beyond a limited period of time; a circumstance detrimental to the successful accomplishment of scientific work of a more intricate character. To give a somewhat more reasonable compensation for their services would serve a twofold desirable purpose; *i. e.*, secure good work and prepare some graduates of our college for teachers in the higher branches of scientific and industrial education. It needs no additional arguments to show that the kind, the character and the extent of the services which this new institution shall render to the State, stand in a direct relation to the character and the special scientific skill of those charged with the work.

The best use which can be made of the results of a well-conducted experiment or analysis obtained in a public institution like the State Agricultural Experiment Station, consists in placing them at once in the hands of those interested in its work. To meet this end monthly bulletins, containing short statements of the work accomplished, have been sent out. The special calls for these publications increased rapidly from three hundred to two thousand. Want of means necessitated the discontinuance of these bulletins since November. There is at present no prospect of issuing new bulletins for several months hence, on account of the low state of finances. The work in barn and laboratories continues from day to day, and the results are allowed to accumulate without serving their principal purpose.

The activity of the station has not infrequently, for this reason, been exposed to an undeserved unfavorable criticism. More facts of a similar character might be presented, if needed, to justify the request to ask for better working rooms, better apparatus and a more liberal appropriation of money, to meet the united call of the working farmers of the State.

Other States, with less agricultural interests at stake, have appropriated of late more than twice the sum for their exper-

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iment stations than we receive at present, with a larger field of investigation assigned by our State laws.

In concluding my report, it gives me pleasure to express my sincere thanks for the kind consideration I have enjoyed from you during the past year, in the management of my charge.

I am, very respectfully,

C. A. GOESSMANN,
Director of the State Experiment Station

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COMMUNICATION FROM PROF. S. T. MAYNARD.

1. Observations in Regard to Insects Injurious to the Apple.

In the growth of all kinds of farm or garden crops, the farmer and gardener find themselves forced to wage constant warfare with insects or parasitic plant life. In this paper we give the results of a few observations in regard to the plum weevil or curculio (*Conotrachelus nenuphar*), as affecting the apple crop, compared also with the codling moth and the apple maggot.

It has often been noticed, early in the summer, that apples nearly all fall from the trees when quite small. This was especially the case during the past season, and a careful investigation was made to ascertain the cause. A tree of the variety known as the Westfield Seek-no-further, which blossomed very abundantly and set an unusually large crop of fruit, was selected. When from one-half to one inch in diameter, the fruit began to drop in large numbers, so that not enough was left on the tree for one-half a crop. A large quantity of these were collected and examined, and out of eight hundred it was found that all but three were punctured by the plum curculio, leaving its peculiar crescent-shaped mark, and in every puncture was found an egg or small larva. The worms commonly found in the apple at this time have generally been supposed to be the larvæ of the codling moth (*Carpocapsa pomonella*), yet in the number examined only four or five of the larvæ of the latter were found.

The remedies which have been successfully employed to prevent the injury of the plum crop by these larvæ are two; *i. e.*, (1) that of jarring the trees and catching the insects and affected fruit in a sheet stretched on a frame or spread

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on the ground, and destroying them; and (2) that of planting the trees in limits of poultry yards. The first remedy cannot be applied to the apple tree on account of its size. The second has proved successful in saving the plum crop, and would undoubtedly be as successful with the apple; but the fowls should be numerous enough to not only catch the insects when they come from the ground, but also to let none of the larvæ escape when they come from the fallen fruit to go into the ground. Perhaps a more sure preventive would be, in addition to the above, to have the fruit destroyed by pasturing swine in the orchard in sufficient numbers to eat all of the fruit as soon as it drops.

The apple crop is also very much injured by the larvæ of the codling moth, mentioned above, which has been common for a long time, and the apple maggot (*Tripeta pomonella*), which has only done serious damage within the past five years. The latter injures the fruit by making burrows in the flesh, many larvæ or maggots often working in the same apple. The eggs are laid by a small fly, — somewhat resembling the common house-fly, but not more than one-half its size, — through a small opening in the skin of the apple made with its ovipositor. It shows especial liking for the thin-skinned, mild, sub-acid or sweet summer or autumn varieties, but also attacks some winter varieties. Its ravages have become so extensive in some localities that prompt measures must be taken for its extermination, or it may work the total destruction of the apple crop.

The practice of pasturing swine in the summer is being recommended and practised by many of our leading farmers and stock-breeders, and the orchardist must combine to a certain extent this branch of business with his own if he would be successful, for the destruction of the fruit as it falls from the tree is the only *safe* and *sure* remedy now known to prevent injury by these three insects.

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2. Notes upon Insects Injurious to Farm and Garden Crops.

In the First Annual Report of the station is to be found a statement of experiments made to ascertain the best means of destroying the many insects that make havoc among the crops of the farm and garden. Some of the experiments gave satisfactory results, and extended preparations are being made to learn more of the *more harmless materials* that may be used as insecticides. As the results cannot be presented to the public in time to be of use the early part of this season, we give a brief statement of the remedies thus far found to be the most successful.

Cabbage Flea. — The first insect of importance that appears is the small black flea or jumping beetle that attacks the cabbage, radish, turnip, etc. Dusting with paris green mixed with one hundred times its weight of plaster has proved an effectual remedy. This must be done when the plants are wet, and after every rain.

Cut-worm. — The cut-worm, of which there are several species, including the army worm, works only during the night, and may be destroyed by the same remedy as the above. We would advise a trial of pyrethrum powder mixed with five times its bulk of plaster as being more safe, although we have no positive proof that it will be effectual.

Striped Squash-Bug. — The striped squash-bug, which has been so abundant for the past two seasons, is best kept in check by the use of plaster and paris green. For the family garden the safest and most satisfactory way to overcome them is to make a bottomless box twelve inches square and six or eight inches deep, and cover it with mosquito netting. One of these boxes placed over each hill until the plants have become tough and hard, is a sure protection.

The Potato Beetle. — The potato beetle has evidently become a permanent resident among us. Paris green extended with plaster, flour or water, is the only cheap and easily applied remedy known at present; but great care must be exercised in its use, and especially in the place where the package is kept, that it may not get upon the food of animals.

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Cabbage Worm.—The cabbage worm, the larva of the common white butterfly, may be easily destroyed in several ways. That of hand-picking, if begun before the first brood has passed into its perfect state, is effectual. We have also found that pyrethrum powder mixed with five times its bulk of plaster, and dusted into the centre of the leaves with sulphur bellows, is certain destruction to every one of them. The application of insecticides in liquids to the cabbage has not been satisfactory, on account of the peculiar structure of the leaf surface, which allows the water to roll off in drops, and not adhere to any part of it. Paris green is unsafe to use after the leaves have become over four inches in diameter.

Currant Worm—The currant worm should be destroyed while small, with the dust of hellebore or pyrethrum. The latter being perfectly harmless is to be more highly recommended.

Plum Weevil.—There are two certain methods of capturing the plum weevil; the first by jarring the tree early in the morning and catching them upon sheets stretched below upon a frame or upon the ground, and the second by placing chicken coops under the trees. The former method must be attended to regularly every morning for three weeks after the plums have set; and in the latter case, if the number of trees is large, a large flock of chickens will be required to make that remedy effectual.

Codling Moth.—No positive remedy against the ravages of this insect has as yet been found. It is claimed that paris green sprayed over the tree in water is effectual; but should it prove so, it is far too dangerous a remedy to apply where grass or other crops are growing under them.

Apple and Peach Borer.—For the destruction of these two insects no sure remedy has been found, except the knife. It is probable that covering the trunk of the tree near the ground with the ink or tar used to catch the moths of the canker worm, or wrapping around the trunk bands of tarred paper, would assist in keeping them away.

The Rose Bug.—The rose bug has thus far been the most difficult to overcome of the whole tribe of injurious insects, and we can recommend no remedy with a great degree of confidence, but would advise the trial of the fumes of gas tar

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held under the vines a short time every evening while the grapes are forming. It is certainly offensive to them, and if used carefully need not injure the plant.

Rose Slugs. — This insect is easily destroyed by spraying with water and pyrethrum, at a rate of one tablespoonful of the latter to a pailful of the former.

Letters. — Several letters have been received asking for information in regard to insects and fungus injurious to plants, which have been answered by letter, and for general information we insert the answers of a few of them.

Letter No. 1, containing shoots of the apple tree covered with a coating of black masses containing some fungus growth. These black masses are the result of dust adhering to the shoots made sticky by the exudations of the common apple aphis or plant louse, which were unusually abundant the past two seasons and caused great injury to young trees. The remedy is to syringe with strong soapsuds, or with a tablespoonful of pyrethrum in a pail of water.

Letter No. 2, containing twigs of the peach tree in which were found a double row of the eggs of the tree cricket (*Oecanthus niveus*). This insect lays its eggs more commonly in the branches of the raspberry and blackberry, but in some cases in those of the peach and plum. The larvæ, after hatching, leave the twigs and for a time feed upon plant lice, and later in the season upon succulent ripe fruits. The tree cricket is light green in color, and when full grown is about three-fourths of an inch long, and lays its eggs in autumn in the centre of the shoots in long lines, as mentioned above.

3. On the Causes of Certain Diseases of Grasses.

June Grass and White Top. — To this grass, on account of the many inflorescences that fail to mature and turn white, is often given the name of *white top*, and the question is often asked, "What is the cause of this condition?" Upon careful investigation it has been found that this condition is most prevalent upon land exhausted by long cropping, or where the roots have been much injured by the larvæ of the June bug or May beetle. The turning of the top to a white color is due to the destruction of the culm or stalk, just above

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the last leaf, by a fungus growth. Upon rich land, and where there are few insect larvæ working at the roots, there is little or none of this white top, and we are led to reason that the fungus does not attack the stem of the grass until the cells have become weakened in some way.

4. Observations Regarding the Vitality of the Seed of Various Weeds.

The several subjects submitted to me for answers by the Board of Control have been carefully investigated, and I am able to make the following report: —

1. How is the vitality of the seeds of our most common weeds, such as dock, sorrel, chickweed, shepherd's purse, white daisy, etc., affected by the action of the digestive organs of animals?

Answer. Seeds of the dock, sorrel, daisy and shepherd's purse were fed to a horse and the refuse collected. Upon careful examination it was found that the seeds, unless crushed, were uninjured, and germinated readily when placed in soil, under proper conditions of heat and moisture. The experiment was repeated several times with the same result.

2. How is the vitality of the common weed seeds, like the above, affected by the action of the compost heap?

Answer. Having settled the point that weed seeds are not destroyed by the action of the digestive organs of animals, it becomes important to know how their vitality may be destroyed; for while the thorough farmer should never allow weeds to mature their seeds on his farm, there are many instances where it becomes necessary to provide some means by which chance seeds may be destroyed. A series of experiments were carried out, the result of which is, that seeds are destroyed if exposed to a temperature of from 90° to 110° F. for from five to seven days in a moist compost heap. In a dry compost heap, where the temperature runs as high as the above, the seeds were found but little injured. The tests were applied only to the above-named seeds; but it is probable that the results would be the same upon others, as these are among the seeds of the greatest vitality. The efficiency of this mode of destruction depends upon the maintenance of a continued high temperature and moisture,

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which will cause the seeds to either germinate and then decay, or to decay before germinating. The amount of moisture can be easily regulated, and by properly working over any pile of compost containing a large amount of organic matter, the required amount of heat may be obtained. From the above experiments it would seem doubtful if the practice of keeping swine upon manure piles, to cause slow decomposition, is the best for manure containing weed seeds. It is also doubtful if the seeds of weeds, often put into the pens where pigs are kept, will be destroyed by the action of the little heat there generated. It would probably be safer, in both of the above cases, to compost the manure in large piles before using it upon the land.

3. At what stage of blooming are the seeds of the white daisy (*Leucanthemum vulgare*) matured enough to germinate?

Answer. This weed has become so abundant in the grass land of some sections of the State that it must be cut with the grass, and it becomes important to know if it can be cut with the grass before the seeds mature. After a series of careful examinations it has been decided that when the flower first reaches its full expansion few or no seeds are mature enough to germinate, but that it requires only a few days for these seeds to mature to full ripeness.

In view of these facts it would not seem safe for the farmer to depend wholly upon the early stage of cutting, but to afterwards compost all manures made from fodder containing weed seeds of any kind.

5. Vitality of Seeds as Affected by Age.

The question of the vitality of seeds as affected by age, is one of great importance to every cultivator of the soil, and while our experiments are far from being complete, as far as the number of varieties are concerned, yet we give the results, hoping at some future time to extend the tests to other varieties of seeds and perhaps to those of greater age.

The temperature, moisture and other conditions, during these tests, were made very nearly that required for the best growth of each kind, and *duplicate* tests were made, in all cases, to insure accuracy.

For each test ten seeds were taken, and the results are given below: —

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Collection No. 1.

(Put up by Wm. Lyman, Leverett, Mass., in 1868.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	Pop-corn,	–	20
2	Yellow Field Pumpkin,	–	20
3	Tomato,	–	20
4	White Spine Cucumber,	–	20
5	Boston Marrow Squash,	–	20
6	Stowell's Evergreen Corn,	–	20
7	Pepper,	1	2
8	Mountain-Sweet Watermelon,	–	20
9	Ox-heart Cabbage,	–	20
10	Giant White Celery,	–	20
11	Large Red Wethersfield Onion,	–	20
12	Sage,	–	20
13	Early Horn Carrot,	–	20
14	White Flat Turnip,	1	14
15	Drumhead Lettuce,	–	20
16	Early Scarlet Radish,	–	20
17	Early Turnip Beet,	5	16
18	Large Dutch Parsnip,	–	20
19	Dan O'Rouke Pea,	–	20

Collection No. 2.

(Collected by Student, from 1868 to 1872.)

1	Com'n Golden Rod (Solidago Nemoralis),	–	20
2	Com'n Golden Rod (Solidago Lanceolata),	–	20
3	Com'n Golden Rod (Solidago Canadense),	–	20
4	Com'n Plantain (Plantago Major),	–	20
5	Apple,	–	20
6	Quince,	–	20
7	White Birch,	–	20
8	Citron Melon,	–	20
9	Musk Melon,	3	12
10	Cucumber,	–	20
11	Hubbard Squash,	6	10
12	Broom Corn,	–	20
13	Thoroughwort,	–	20
14	Common Milkweed,	–	20
15	Fire-weed,	–	20
16	Beggar's Tick,	–	20
17	Butter-weed,	–	20
18	Stag-horn Sumac,	–	20
19	Evening Primrose,	–	20
20	Cone Flower,	–	20
21	Tobacco, Connecticut Seed-leaf,	–	20
22	Sweet Brier,	–	20
23	Pigweed,	–	20
24	Curled Dock,	–	20
25	Smartweed,	–	20
26	Sunflower,	–	20
27	Rhubarb,	–	20

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Collection No. 3.

(Collected by Students in 1878.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	White Tazelbe Wheat,	–	20
2	Arnouth Spring Wheat,	–	20
3	Black Swedish Oat,	–	20
4	Somerset Oat,	–	20
5	Schonen White Oat,	–	20
6	Excelsior Oat,	–	20
7	Probstier Barley,	–	20
8	Saxonian Barley,	–	20
9	Red Clover,	10	4
10	Yellow Clover,	10	4
11	Alfalfa Clover,	10	4
12	Alsike Clover,	2	6
13	Bokhara Clover,	5	4
14	White Clover,	6	4
15	Lucerne,	10	4
16	Winter Rape,	10	3
17	Summer Rape,	10	3
18	Desmodium,	–	20
19	Teasels,	–	20
20	Fengreek,	10	3
21	Vetch,	5	10
22	Lentile,	–	20
23	Blue Lupine,	3	6
24	White Lupine,	10	6
25	Carter's Imperial Pea,	–	20
26	Nohoot Pea,	–	20

Collection No. 4.

(Seed taken from a German Collection made in 1878.)

1	Trifolium Pratense,	5	7
2	Trifolium Hybridum,	4	7
3	Festuca Ovina (Sheep Fescue),	2	12
4	Festuca Pratensis (Meadow Fescue),	9	12
5	Festuca Duriuscula (Hard Fescue),	–	–
6	Lolium Perenne (Perennial Rye-grass),	3	12
7	Lolium Italicum (Annual Rye-grass),	8	12
8	Poa Pratensis (June-grass),	–	20
9	Poa Nemoralis (Wood Meadow-grass),	–	20
10	Dactylis Glomerata (Orchard-grass),	–	20
11	Agrostis Vulgaris (Red Top),	–	20
12	Agrostis Stotonifera (Creeping Bent-grass),	10	16
13	Anthoxanthum Oderatum,	5	14
14	Alopecurus Pratensis (Meadow Foxtail),	–	20
15	Phleum Pratense (Timothy Hay),	8	12
16	Aira Flexuosa (Hair-grass),	–	20
17	Medicago Sativa (Lucerne),	10	5

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COLLECTION NO. 5.

(Seeds put up by J. M. Thorburn & Co., 1883.)

		No. of Seeds Germinating.	No. Days before First Seed Started.
1	Festuca Ovina (Sheep's Fescue),	–	20
2	Festuca Elatior (Meadow Fescue),	5	9
3	Festuca Rubra (Red Fescue),	10	9
4	Festuca Duriuscula (Hard Fescue-grass),	2	9
5	Poa Pratensis (June-grass),	4	10
6	Agrostis Vulgaris (Red-Top grass),	–	–
7	Agrostis Stotonifera (Creeping Bent-grass),	–	–
8	Bronus Mollis (Soft Chess-grass),	4	9
9	Lolium Perenne (Perennial Rye-grass),	10	9
10	Lolium Italicum (Annual Rye-grass),	6	9
11	Alopecurus Pratensis (Meadow Foxtail),	–	–
12	Aira Flexuosa (Hair-grass),	–	
13	Avena Elatior (Oat-grass),	4	9
14	Avena Flavescens (Yellow Oat-grass),	5	10
15	Dactylis Glomerata (Orchard-grass),	7	9
16	Authoxanthum Oderatum (Sweet Vernal-grass,	8	10
17	Phleum Pratense (Timothy-grass),	9	9
18	Panicum Germanicum (Hungarian Millet),	8	9
19	Phalaris Arundinancea (Blue Joint-grass),	6	9
20	Holcus Lanatus (Soft Grass),	6	9
21	Cynosurus Cristatus (Crested Dogtail),	10	10
22	Reana Luxurieus,	–	–
23	Bermuda Grass,	–	–
24	White Clover,	10	2
25	Red Clover,	10	2
26	Crimson Clover,	10	2
27	Alsike Clover,	10	2
28	Alfalfa Clover,	10	2
29	Yellow Clover,	10	2
30	Bokhara Clover,	10	2
31	White Lupine,	10	7
32	Blue Lupine,	5	6
33	Yellow Lupine,	6	6
34	Vetch,	10	6
35	Horse Bean,	10	7
36	Spurry,	4	6

It will be seen that those varieties which, as a rule, are most hardy and productive, and consequently most generally planted, have generally retained their vitality the longest.

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6. The Destruction of Peach Buds by Cold.

In New England one of the greatest obstacles met with in the cultivation of the peach is the destruction of the fruit buds by cold.

Many theories have been advanced to account for this injury, and in order to obtain definite knowledge of the condition of the buds during the season when the injury takes place, examinations were made at intervals of from three to five days from November 15th to the time of their destruction. At the beginning of the examinations, the buds were all found to be in a fully matured condition and the bud scales very closely united, making the bud firm and compact. This condition continued until after the warm days of the last of November.

December 6th the buds scales were found to have loosened and the stamens and pistils to have increased very much in size. December 16th some buds were found to have been destroyed altogether. The temperature at this time had only reached 18° above zero. Most of the buds, however, only indicated an advanced stage of growth; in a few instances, the rudimental petals began to take on some color.

Upon examination after the severe cold of December 19th and 20th, every bud examined, whether growing upon high or low land, or with a northern or southern exposure, was found to be destroyed.

The facts brought out by the above examination, were as follows: that the buds were started into growth by the warm days of the last of November and the first of December; that in this condition some of them were destroyed at a temperature of 18° above zero; and that all were destroyed when the temperature reached 10° below zero.

What would have been the effect of this amount of cold upon buds in a less advanced state of growth, cannot be determined until we have a season less favorable for their development.

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ON FEEDING EXPERIMENTS.

C. A. GOESSMANN.

Careful investigations in stock-feeding have taught us lessons similar to those we have learned to appreciate in feeding plants, or in the cultivation and the production of farm crops. All our farm plants need nitrogen, phosphoric and sulphuric acids, potassa, soda, lime, magnesia and iron; yet not two species of plants have been found, which need the same quantity of these substances, during their entire period of life, nor at any stage of their growth. No one of the above-stated essential mineral constituents of plants can replace another one to any extent without altering the character of the plant, or even endangering its life. Potassa cannot take the place of lime, nor phosphoric acid that of sulphuric acid. When lime is needed, a shovelful of that substance is worth more than any quantity of the many times more expensive potassa. That particular mineral element which supplies an actual want of the soil is, for this reason, from a physiological standpoint, considered the most important one for the production of the plant; for without it the remaining essential mineral constituents of plants, whatever their quantity may be, cannot make them grow.

In regard to the growth and the support of our farm live stock, similar relations have been noticed. Actual feeding experiments have shown that three groups of plant constituents (nitrogenous, non-nitrogenous, and mineral constituents) are required to sustain successfully animal life. No one or two of them, alone, can support it for any length of time. In case the food does not contain digestible non-nitrogenous substances, the fat and a part of the muscles of the animal on trial will be consumed in the support of respi-

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ration before its life terminates. In case nitrogenous constituents are excluded, the formation of new blood and flesh from the food consumed ceases, for the animal system is not capable of producing their principal constituents from anything else than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances directly from the plants; carnivorous animals indirectly, by feeding on herbivorous animals. We feed, at present, our farm stock too frequently without a due consideration of the general natural law of nutrition; to deal out our fodder crops only with mere reference to name, instead of making ourselves more familiar with their composition and their particular quality, deprives us even of the chance of drawing an intelligent conclusion from our present system of feeding.

To compound the animal diet with reference to the *particular organization* of the *animal*, its *age* and its *functions*, is of no more importance than to select the fodder substances with reference to *its special wants*, as far as the *absolute* and *relative quantity* of the *three essential groups* of food constituents are concerned.

The peculiar character of our home-raised fodder articles is apt to conceal their special deficiency for the various purposes they are used for in a general farm management. They all contain the three essential food constituents, yet in widely varying proportions, and they ought, therefore, to be supplemented in different directions, to secure their full economical value. To resort to more or less of the same fodder article to meet the special wants, may meet the case as far as an *efficient* support of the animal is concerned, yet it can only in exceptional cases be considered good economy.

To satisfy the craving of the stomach and to feed a nutritious food are both requirements of a healthy animal diet, which, each in their own way, may be complied with. The commercial fodder substances, as oil-cakes, meal refuse, brans and our steadily increasing supply of refuse material from breweries, starch works, glucose factories, etc., are admirably fitted to supplement our farm resources for stock-feeding; they can serve in regard to animal growth, and support, in a similar way as the commercial fertilizer in the growth of farm crops, by supplementing our home resources.

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To feed an excess of fodder materials, as roots and potatoes, which contain a large proportion of non-nitrogenous substances, as starch, sugar, digestible cellular substance, etc., means direct waste; for they are ejected by the animal, and do not materially benefit the manure heap. In case of an excessive consumption of nitrogenous constituents, a part of the expense is saved in an increased value of the manure, yet scarcely enough to recommend that practice beyond mere exceptional cases. The aim, therefore, of an economical stock-feeding must be to compound our various fodder materials in such a manner that the largest quantity of each of the three groups of fodder substances which the animal is capable to assimilate, should be contained in its daily diet to meet the purpose for which it is kept.

To compound the fodder rations of our farm stock with reference to the special wants of each class of them, is an essential requirement for a satisfactory performance of their functions; to supply these wants in an economical way controls the financial success of the industry.

The problem is an intricate one; years of careful experimenting were required to accumulate observations sufficient in number and in quality, to impart to the conclusion arrived at the claim of being worthy of a serious consideration. The first attempt to lay down rules for compounding the fodder rations of all kinds of farm stock on rational scientific principles, was made by Dr. Grouven, director of the Agricultural Experiment Station at Salzmünden, Germany, 1858–1864. He began his work with a critical compilation of feeding experiments made by competent parties, some ninety in number, his own extensive experiments included. He ascertained in each case the amount of each fodder substance consumed per day during each experiment; and calculated subsequently, from their analyses, the character and the amount of the daily fodder rations.

By this operation he learned the exact amount of nitrogenous, non-nitrogenous and mineral substances digested per day, under definite circumstances, by each class of farm animals. The amount of fat which had been fed in the fodder substances was separately recorded, on account of its exceptionally high feeding value, as a heat-producing material.

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The results of his calculations were repeatedly tried by actual feeding experiments, to test the correctness of his conclusions. The main object of Grouven's work consisted in bringing the results of more than twenty years' careful investigations within the reach of the practical farmer. In presenting his fodder standards to them, he recognized the natural imperfections of a first effort, More than twenty years additional experience in leading European agricultural experiment stations has modified some details in Grouven's statement; yet the great value of his method to compound rational, and thus more economical fodder rations for farm animals, has received an unqualified endorsement.

For more details regarding the subject here under discussion I refer to some previous publications contained in the reports of the Secretary of the Massachusetts State Board of Agriculture; see 1879–80, pages 221 to 237; 1882–83, pages 89 to 127.

The station proposes to benefit by the lessons of the past as far as the application of the method of compounding fodder rations for various kinds of live stock is concerned; yet leaves the working out of a rational and economical diet to the teachings derived from home experiments. The results of a few feeding experiments carried on at the station are reported with such details as will enable the student of a rational system of stock-feeding, as well as the farmer, to obtain the desired information. Whenever our results have accumulated in sufficient degree to entitle to a generalization, a more detailed discourse will follow.

I. — Notes on Feeding Experiments with Corn Ensilage.

The experiments were chiefly carried on for the purpose of testing the feeding value of corn ensilage, as compared with that of hay. A description of the general character of the ensilage, as well as of the hay and corn meal used in this connection, will be found upon a few subsequent pages within this report.

Three cows — crosses between native stock and Ayrshires — of a corresponding milking period — were selected from the herd of the Massachusetts Agricultural College, to serve

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for the trial. The previous mode of feeding, the amount of each article of fodder actually consumed per day, and the daily yield of milk, were carefully noted during the week preceding the removal of the animals to the stalls of the station (April 7–14). Each cow had received for some time previous to that date, four quarts of clear corn meal per day, together with all the hay they could consume.

This mode of feeding was continued at the station, from April 14 to 29, by careful application of the scale in all measurements to secure reliable values for comparison.

History of Cows.

I. Name, FAIRY; age, 5 years; weight, 862 pounds; number of calves, 2; last calf, Feb. 20, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 17 pounds of hay per day. Average yield of milk per day, 18½ pounds (April 14 to 30).

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C.,	87.46	87.67	87.54
Total solids,	12.54	12.33	12.46
Fat (in solids),	3.33	3.20	3.34

Mean of Three Analyses.

Water,	87.56
Total solids,	12.44
Fat (in solids),	3.29

II. Name, NELLIE MAY; age, 4 years; weight, 860 pounds; number of calves, 2; last calf, Feb. 15, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 16½ pounds of hay per day. Average yield of milk per day, 14½ pounds.

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C.,	87.57	87.18	87.09
Total solids,	12.43	12.82	12.91
Fat (in solids),	3.71	3.82	3.87

Mean of Three Analyses.

Water,	87.28
Total solids	12.72
Fat (in solids),	3.80

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III. Name, CLARA; age, 5 years; weight, 895 pounds; number of calves, 3; last calf, Feb. 25, 1884; feed, 4 quarts of clear corn meal (6½ pounds) and 15½ pounds of hay per day. Average yield of milk per day (April 14 to 30) 15½ pounds.

COMPOSITION OF MILK.	April 8.	April 11.	April 14.
Water at 100° C.,	88.04	87.32	87 39
Total solids,	11.96	12.68	12.61
Fat (in solids),	3.27	3.48	3.56

Mean of Three Analyses.

Water,	87.58
Total solids,	12.42
Fat (in solids),	3.44

Statement of Dry Vegetable Matter Consumed in form of Hay and Corn Meal by each Cow before Ensilage was introduced.

I.—FAIRY.

		Dry Matter.	Cost.
Hay consumed per day,	17.00 lbs.	15.30 lbs	12.75 cts.
Meal consumed per day,	6.50 lbs.	5.60 lbs.	9.10 cts.
	23.50 lbs	20.90 lbs.	21.85 cts.

Daily produce of milk,	9¼ quarts.
Cost of fodder per day,	21.85 cents.
Cost of milk per quart,	2.36 cents.

II.—NELLIE MAY.

		Dry Matter.	Cost.
Hay consumed per day,	16.33 lbs.	14.70 lbs.	12.25 cts.
Meal consumed per day,	6.50 lbs.	5.60 lbs.	9.10 cts.
	22.88 lbs.	20.30 lbs.	21.35 cts.

Daily produce of milk,	7¼ quarts.
Cost of fodder per day,	21.35 cents.
Cost of milk per quart,	2.93 cents.

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III. — CLARA.

		Dry Matter.	Cost.
Hay consumed per day, . . .	15.46 lbs.	13.90 lbs.	11.60 cts.
Meal consumed per day, . . .	6.50 lbs.	5.60 lbs	9.10 cts.
	21.96 lbs.	19.50 lbs.	20 70 cts.

Daily produce of milk, ...	7.6 quarts.
Cost of fodder per day, ...	20.7 cents.
Cost of milk per quart, ...	2.7 cents.

After the previously stated mode of feeding, and the quantity and quality of the milk obtained thereby, had been carefully tested during two weeks' observation under the management of the station,

Corn Ensilage

was introduced as an additional article of the daily diet, in the following way: The amount of corn meal, four quarts (6½ pounds) per day, remained the same during the entire trial. The ensilage was gradually substituted for the hay in the daily fodder, as the animal felt disposed to consume it. During the first twelve days of the experiment, each was offered forty pounds of ensilage per day, and subsequently sixty pounds, besides all the hay they would consume. They varied widely in their preference, as subsequent detailed statements show. The manner of feeding was as follows: At 5.30 A. M. the meal and shorts were fed to the animals during milking, and at 6 o'clock the ensilage; at 12 o'clock, M., from four to five pounds of hay were offered, and at 5 P. M. the remainder of the meal was given, and the rest of the ensilage soon after. At 8 o'clock, P. M. from four to five pounds of hay were again offered. Any material remaining after each feeding was removed and weighed. As a rule, they consumed first the leaves of the corn, and left,

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if any, more or less of the harder stem parts behind. They received twice per day all the water they would drink.

I.—Name, FAIRY.

[A.] *Record of Month of May.*

1884. FEEDING PERIOD.	Food Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1–6, ...	6½	8	40	10	9	18.
6–12, ...	6½	8	40	10½	9	18.
12–18, ...	6½	7½	59	10	9	19.9
18–31, ...	6½	7½	54½	10	9	19.4

Analyses of Milk.

Water, ...	87.16	86.99	86.84	87.33	87.55	87.57
Solids, ...	12 84	13.01	13.16	12.67	12.45	12.43
Fat (in solids), ...	4.08	3.88	3.93	3.60	3.29	3.37

Mean of Three Last Stated Analyses of Milk.

Water, ...	87.41
Solids, ...	12.59
Fat (in solids), ...	3.43

The cows, with the exception of No. III., retained their original weight well.

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[B.] *Record of Month of June.*

	Food Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	6½	–	8	55	9½	8	17½	20.0	–
2, . .	"	–	8	60	9½	8	17½	20.6	–
3, . .	"	–	8	60	10	9	19	20.6	885
4, . .	"	–	8	60	10	9½	19½	20.6	–
5, . .	"	–	7	60	10	9½	19½	19.7	–
6, . .	"	–	8	60	10½	9½	20	20.6	–
7, . .	"	–	8	60	10	9½	19½	20.6	–
8, . .	"	–	7	58	11½	9	20½	19.5	–
9, . .	"	6½	7	60	11	9½	18½	25.4	–
10, . .	"	"	7	60	11	9	20	25 4	–
11, . .	"	"	7	60	11	9	20	25.4	–
12, . .	"	"	6	60	11	10	21	24.5	–
13, . .	"	"	6	60	11	10	21	24.5	–
14, . .	"	"	7	55	11	10	21	24.8	–
15, . .	"	"	8	60	11	10	21	26.3	–
16, . .	"	"	8	57	11	10	21	25.9	–
17, . .	"	"	16		11	10	21	25.7	910
18, . .	"	"	15		10½	10	20½	24.8	–
19, . .	"	"	15	Discontinued; stock of ensilage exhausted.	11	10	21	24.8	–
20, . .	"	"	14		10½	10	20½	23.9	–
21, . .	"	"	14		10	10	20	23.9	–
22, . .	"	"	14		10½	10	20½	23.9	–
23, . .	"	"	15		10	9½	19½	24.8	–
24, . .	"		*16		10½	9	19½	20.0	885
25, . .	"		*20		10½	10	20½	23.6	–
26, . .	"	Discontinued.	*20		10½	9½	20	23.6	–
27, . .	"		*20		10	9½	19½	23 6	–
28, . .	"		*20		10	10	20	23.6	–
29, . .	"		*20		10	10	20	23.6	–
30, . .	"		*20		10	10	20	23.6	–

* New hay.

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Analyses of Milk.

	June 10.	June 16.	June 30.
Water,	87.10	86.60	87.36
Solids,	12.90	13.40	12.64
Fat (in solids),	3.61	3 83	3.53

II. — Name, NELLIE MAY.

[A.] *Record of Month of May.*

1884. FEEDING PERIOD.	Food Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1–6,	6½	7½	40	8½	7½	17.6
6–12,	6½	7½	40	8½	7	17.4
12–18,	6½	6	54	8	7½	18.1
18–31,	6½	5¾	45½	8	7½	16.7

Analyses of Milk.

	May 3.	May 7.	May 12.	May 20.	May 23.	May 28.
Water,	87.00	87.09	87.43	87.39	87.19	87.37
Solids,	13.00	12.91	12.57	12.61	12.81	12 63
Fat (in solids),	3.81	3.91	3.86	3.80	3 68	3.68

Mean of three last stated Analyses of Milk.

Water,	87.32
Solids,	12.68
Fat (in solids),	3.72

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[B.] *Record of Month of June.*

	Food Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	6½	–	7	37	8	7	15	16 7	–
2, . .	"	–	8	28	8	7	15	16.4	–
3, . .	"	–	7	35	8½	7	15½	16.7	852½
4, . .	"	–	6	40	8½	8	16½	16.2	–
5, . .	"	–	5	40	8	8	16	15.3	–
6, . .	"	–	7	40	9	8	17	17.1	–
7, . .	"	–	7	40	9	8½	17½	17.1	–
8, . .	"	–	5	40	10½	8	18½	15.3	–
9, . .	"	6½	5	40	10	9	19	21.0	–
10, . .	"	"	7	40	10	8½	18½	22.8	–
11, . .	"	"	7	40	10	9	19	22 8	–
12, . .	"	"	7	40	9½	9	18½	22.8	–
13, . .	"	"	6	40	10	9	19	21.9	–
14, . .	"	"	6	40	10	9	19	21.9	–
15, . .	"	"	7	40	10	9	19	22.8	–
16, . .	"	"	7	40	10	10	20	22.8	–
17, . .	"	"	16	40	10	10	20	25.7	895
18, . .	"	"	14	Discontinued; ensilage exhausted.	9½	9	18½	23.9	–
19, . .	"	"	13		9½	9	18½	23.0	–
20, . .	"	"	13		9½	9	18½	23.0	–
21, . .	"	"	14		9½	9	18½	23.9	–
22, . .	"	"	14		9½	9	18½	23.9	–
23, . .	"	"	15		9	9	18	24.8	–
24, . .	"	Discontinued.	*16		10	9	19	20.0	902
25, . .	"		*20		9½	9	18½	23.6	–
26, . .	"		*16		9½	9	18½	20.0	–
27, . .	"		*20		9	9	18	23.6	–
28, . .	"		*20		9½	9	18½	23.6	–
29, . .	"		*20		9½	9	18½	23.6	–
30, . .	"		*20		9	9	18	23.6	–

*New hay.

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Analyses of Milk.

	June 16.	June 20.
Water,	86.89	87.20
Solids,	13.11	12.80
Fat (in solids),	3.81	3.83

III. — Name, CLARA.

Record of Month of May.

1884. Feeding Period.	Food Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.		Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).
	Indian Meal.	English Hay.	Ensilage.	Morning.	Evening.	
Periods.						
May 1–6,	6½	7	33½	8½	7½	16.3
6–12,	6½	7	29½	8	7	15.8
12–18,	6½	5½	34½	7⅞	7	14.9
18–31,	6½	5½	28	7	6½	14.1

The experiment with Clara was discontinued at the end of this month on account of her distaste for ensilage.

Analyses of Milk.

	May 3.	May 7.	May 12.	May 20.	May 23.	May 26.
Water,	87.25	87.39	87.20	87.69	87.88	87.97
Solids,	12.75	12.61	12.80	12 31	12.12	12.03
Fat (in solids),	3.68	3.62	3.66	3.47	3.21	3.47

Mean of three last stated Analyses of Milk.

Water,	87.85
Total solids,	12.15
Fat (in solids),	3.39

Melia (IV.) takes the place of Clara.

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IV.—Record of MELIA.

Ayrshire; 11 years old; dropped last calf Feb. 15, 1884.

[Melia consumed larger quantities of ensilage, and has taken the place of III. (Clara) in our previous feeding.]

	Feed Consumed (lbs.) per Day.				Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal.
	Corn Meal.	Wheat Shorts.	Hay.	Ensilage.	Morning.	Evening.	Total.		
June 1, . .	–	–	–	–	–	–	–	–	–
2, . .	–	–	–	–	–	–	–	–	–
3, . .	6½	–	7	20	14	13½	27½	14.5	692½
4, . .	"	–	6	40	15	14½	29½	16.2	–
5, . .	"	–	5	40	14	14	28	15.3	–
6, . .	"	–	5	40	15	13½	28½	15.3	–
7, . .	"	–	6	40	14	13½	27½	16.2	–
8, . .	"	–	5	40	15½	12	27½	15.3	–
9, . .	"	6½	6	50	14	13	27	23.2	–
10, . .	"	"	5	58	14	12½	26½	23.4	–
11, . .	"	"	5	59	14½	13	27½	23.5	–
12, . .	"	"	5	60	15	12	27	23.6	–
13, . .	"	"	6	60	14½	12	26½	24.5	–
14, . .	"	"	5	60	14	13	27	23.6	–
15, . .	"	"	5	60	14	13	27	23.6	–
16, . .	"	"	5	60	14	14	28	23.6	–
17, . .	"	"	12	Discontinued; stock of ensilage exhausted.	13½	14	27½	22.1	755
18, . .	"	"	14		13	14	27	23.9	–
19, . .	"	"	12		13½	13	26½	22.1	–
20, . .	"	"	12		13½	13	26½	22.1	–
21, . .	"	"	12		14	12	26	22.1	–
22, . .	"	"	14		14	13	27	23 9	–
23, . .	"	"	14		13	13	26	23.9	–
24, . .	"	Discontinued.	*16		14	12	26	20.0	760
25, . .	"		*19		14	12	26	22.7	–
26, . .	"		*16		13	11½	24½	20.0	–
27, . .	"		*20		13	11	24	23.6	–
28, . .	"		*20		12	11	23	23.6	–
29, . .	"		*20		12	11	23	23.6	–
30, . .	"		*20		12	10½	22½	23.6	–

* New hay.

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Analyses of Milk.

	June 16.	June 30.
Water, ...	87.84	88.29
Solids, ...	12.16	11.71
Fat (in solids), ...	3.21	2.99

Summary of Observations under Existing Circumstances.

1. The cows differed widely in their preference for ensilage.

2. Reducing the ensilage to the same state of dryness noticed in the hay, we find that the total quantity of *dry vegetable matter* previously consumed has been considerably reduced, in consequence of the introduction of the ensilage. This is more apparent in Nos. II. and III., than in No. I.

3. The quantity of milk has, in every instance, increased, in consequence of the addition of ensilage to *our customary mode of feeding*, counting the amount of dry vegetable matter, in each case, pound for pound with the milk produced.

4. The increase in quantity of milk, counting on the basis of the total amount of fodder consumed, was most pronounced in case of moderate quantities of ensilage, i. e., from thirty-five to forty pounds per day.

5. The addition of a liberal amount of wheat shorts (bran) to the daily diet (9th of June), has, in most instances, but slightly affected the absolute yield of milk for the better; and has at no time changed the relative proportions between dry vegetable matter and the yield of milk, in favor of the former, as compared with the feeding of corn ensilage alone as an essential additional constituent of the original daily diet. The main benefit derived from the addition of wheat shorts to the daily fodder rations, consisted, evidently, in the improved appearance of the cows, in the improvement of the milk, and in an increased value of the manure resulting.

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The quality of milk was not perceptibly changed, as far as the *density and the amount of fat was concerned*, with the exception, when a liberal amount of shorts were fed. None of the mean results obtained after feeding ensilage have been below the lowest results before its introduction in the daily diet.

In stating the composition of milk, only, with reference to water, solid matter and fat, it has been by no means assumed,— in following thereby the common usage,— that the information regarding these points suffices, under all circumstances, to establish the normal character of a sample of milk. The total amount and the relative proportions of the various nitrogenous constituents of the milk,— commonly stated by the collective name, casein,—are known to affect, at times, seriously its character.

Observations in that direction quite naturally suggest themselves in the course of our investigation. The results thus far obtained are, however, for various reasons beyond our control, not decisive enough to question, at the present stage of our work, seriously, the good quality of the milk obtained in connection with the feeding of a moderate amount of corn ensilage. The total amount of nitrogenous matter (crude casein) noticed in case of cow No. II. (May 11 and 26) differed but slightly in different samples as far as its absolute quantity and the relative proportions of casein, albumen and lactoprotein are concerned. The milk of cow No. I., the largest consumer of ensilage, showed a somewhat larger amount of total nitrogenous matter, as compared with that from cow No. II.; and the albumen and lactoprotein showed a marked increase. Whether these results will prove hereafter to be merely of an incidental character, or will have to be ascribed to an excessive consumption of ensilage, farther studies at the earliest suitable occasion are designed to show.

The financial side of the ensilage feeding is not discussed in this connection on account of the absence of exact figures regarding the cost of our ensilage.

The analyses of the various articles of fodder used in above stated feeding experiments, — corn ensilage, timothy hay, wheat shorts, and corn meal,— are as follows: —

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ENSILAGE OF CORN IN TASSEL.

[Sample taken from Silo when opened, April 29th.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . . .	86.88	1,737.6	-	-	
Dry Matter, ...	13.12	262.4	-	-	
	100.00	2,000.0	-	-	
Analysis of Dry Matter.					
Crude Ash, ...	6.89	137.8	-	-	
" Cellulose, ...	33.66	673.2	484.70	72	1 : 6.57
" Fat, ...	3.88	77.6	58.20	75	
" Protein (Nitrogenous Matter), ...	12.58	251.6	183.67	73	
Non-nitrogenous Extract Matter, ...	42.99	859.8	576.06	67	
	100.00	2,000.0	1,302.63	-	

The silo which furnished this ensilage has been described in the first Annual Report of the station. The fodder corn which filled the silo was well tasselled out, and had, a few days previously, suffered from a severe frost on the night of September 3d; it had been cut into pieces from two to three inches in length, before it had been tramped down, covered and subjected to a pressure of sixty pounds to a square foot of surface. The silo was opened for the use of its contents on April 29th. The color of the ensilage was dark yellowish green; it had an acid taste and odor. On the top of the mass and around its sides could be noticed, for some inches in thickness, some mould. The main bulk of the mass — judging from the opinion expressed by many visitors to the station, who claimed to be familiar with the usual appearance of corn ensilage — corresponded evidently with a large proportion of the ensilage fed during the past.

A comparison of the above stated analysis of the dried ensilage, with an analysis of the frost-bitten corn fodder collected at the time the silo was being filled, shows a decrease of non-nitrogenous constituents, except in the case of fat; and a decided increase in nitrogenous matter (crude

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protein). The nutritive properties of the corn fodder had been greatly modified in consequence of its treatment in the silo; its nutritive ratio (i. e., relation of nitrogen-containing food constituents to non-nitrogen-containing constituents) had been raised to that of our better grasses.

This result is not an exceptional one *in character;* it is only marked *in degree*, judging from well-endorsed observations in competent hands elsewhere, and is coöperated in the case of all kinds of ensilage. Yet these changes in quality are accompanied by a considerable destruction of valuable organic matter. The fact that the nitrogenous constituents (crude protein) resist better the destructive influences in the ordinary silo, than the non-nitrogenous plant constituents, as starch, sugar, cellulose, etc., is the real cause of the alteration in the nutritive character of the fodder, in consequence of our present management of the silo. An analysis of the liquid, which, under a partial pressure upon our ensilage, accumulated upon the cleaned floor of the silo, admits of no other explanation.

The investigation of the production of a good ensilage, together with a determination of cost as compared with hay, will be resumed at an early date.

Liquid of Ensilage taken from the Bottom of the Silo.

Specific gravity at 20° C., 1.025; 102.5 grams of solution required ½ gram of carbonate of soda for its neutralization.

Moisture at 100° C.,	81.52
Dry matter,	18.38
	100.00

Analysis of Dry Matter.

Sesquioxide of iron,	.04
Calcium oxide,	.85
Magnesium oxide,	1.07
Phosphoric acid,	.20
Potassium oxide,	.81
Sodium oxide,	.16
Nitrogen,	.59

Of the nitrogen found in the liquid .246 parts was present in form of soluble albuminoids and .344 parts in form of ammonia compounds. The liquid contained from three to four per cent. more of solid matter than the original corn fodder.

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CORN FODDER (Frost-bitten).
(IN TASSEL).
[From Experimental Plats of the Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.83	176.6	–	–	1:9.83
Dry Matter,	91.17	1,823.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.86	97.2	–	–	
" Cellulose,	29.05	581.0	418.32	72	
" Fat,	2.06	41.2	30.90	75	
" Protein (Nitrogenous Matter),	8.63	172.6	126.00	73	
Non-nitrogenous Extract Matter,	55.40	1,108.0	742.36	67	
Total,	100.00	2,000.0	1,317 58	–	

This corn fodder served for the production of the previously described corn ensilage. Its frost-bitten condition, and *half matured stage of growth*, have, no doubt, seriously affected the quality and quantity of the ensilage.

TIMOTHY HAY.
[From the Experimental Farm, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.70	174.0	–	–	–
Dry Matter,	91.30	1,826.0	–	–	–
	100.00	2,000.0	–	–	–
Analysis of Dry Matter.					
Crude Ash,	4.04	80.8	–	–	–
" Cellulose,	36.59	731.8	–	–	–
" Fat,	2.12	42.4	–	–	–
" Protein (Nitrogenous Matter),	7.24	144.8	–	–	–
Non-nitrogenous Extract Matter,	50.01	1,000.2	–	–	–
Total,	100.00	2,000.0	–	–	–

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The hay was harvested in July, after blooming. The sample was taken from the barn in November. The article can scarcely be called a fair average quality of its kind.

CORN MEAL.

[From JOHN L. HOLLEY, South Amherst, Mass.]

Ninety-two per cent. passing through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.85	271.0	–	–	1:9.66
Dry Matter,	86.45	1,729.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.			–		
Crude Ash,	1.42	28.4	–	–	
" Cellulose,	2.64	52.8	17.95	34	
" Fat,	4.24	84.4	64 45	76	
" Protein (Nitrogenous Matter),	10.40	208.0	176.80	85	
Non-nitrogenous Extract Matter,	81.30	1,626.0	1,528.44	94	
Total,	100.00	2,000.0	1,787.64	–	

A fair article of its kind.

WHEAT BRAN.

[From JOHN L HOLLEY, South Amherst, Mass.]

Thirty-three per cent. passed through mesh 144 to the square inch (May and June).

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.08	241.6	–	–	1:4.16
Dry Matter,	87.92	1,758.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.92	158.4	–	–	
" Cellulose,	13.72	274.4	54.88	20	
" Fat,	3.81	76.2	60.96	80	
" Protein (Nitrogenous Matter),	15.67	313.4	275.79	88	
Non-nitrogenous Extract Matter,	58.88	1,177.6	942.08	80	
Total,	100.00	2,000.0	–	–	

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This quality of wheat bran, which is of a fair composition, has been used in the previously described feeding experiments.

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2. Notes on Feeding Experiments with Gluten Meal as a Constituent of the Daily Diet of Milch Cows.

The experiment was instituted for the purpose of studying the effect of gluten meal as a constituent of the daily diet of milch cows, on the quantity and the quality of milk obtained, as well as on the cost of its production under several specified circumstances. The same cows which served in the previous trial with corn ensilage, Indian meal, wheat bran and hay, were used in that with gluten meal.

The observations extended over a period of three months. The third period of feeding was not extended beyond two weeks, on account of the bad influence of a too liberal supply of nitrogenous constituents in the daily diet, during very warm weather, on the general condition of the cows.

The mode of feeding was essentially the same as reported on previous occasions. The gluten meal was fed with an equal weight of wheat bran to compensate its deficiency in phosphates of lime and magnesia, and to render it more palatable. The designed amount of both substances was in each instance mixed and moistened, and fed in two meals during milking; the hay followed, mornings, noons and after milking evenings; care being taken to ascertain by weight, before and after meals the exact amount consumed.

The composition and the general character of the gluten meal is described in a few subsequent pages. The cost of the daily fodder rations used in these experiments, are based on our local market prices: gluten meal, $22.50; wheat bran, $23, and hay $15 per ton. Corn meal has cost, during our trials, $28 per ton. It has been the aim, in our subsequent statement of results, to render prominent the controlling influence of the daily yield of milk on its cost under a corresponding system of feeding. It will be noticed, in our trials, that under nearly identical conditions, as far as kind of fodder and period of milking are concerned, the milk of

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one cow, as compared with that of another one, may cost the owner of the animals from forty to ninety per cent. and more in one case than in the other. A careful comparison of the subsequent detailed statement of our late experiment with the previous one, tends to show that a good gluten meal. at the stated cost, ought to be considered a valuable addition to our commercial concentrated fodder articles. The rations fed during the first feeding period and at the close of the experiment (IV. Period), deserve from a standpoint, a trial on the part of dairymen. Our results were satisfactory as far as the yield of milk of a good quality is concerned.

I. — RECORD OF MELIA.

FEEDING (1.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
July 1-8, . .	3¼	3¼	20	13	12⅔	25⅔	23.97	782½
8-15, . .	3¼	3¼	20	14⅔	13	27⅔	23.97	782½
15-22, . .	3¼	3¼	20	13⅔	12⅔	26⅔	23.97	782½
22-29, . .	3¼	3¼	20	14⅓	13	27⅓	23.97	762½
29-Aug. 5, .	3¼	3¼	20	14⅔	13⅔	28⅔	23.97	795

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 1ST PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
113¾ lbs. Gluten Meal, .	100.46	26.44	62.15	3.40	1 : 6.32
113¾ lbs. Shorts, . .	101.84	20.25	54.93	4.34	
700 lbs. Hay, . . .	626.15	35.99	358.64	8.53	
Total, ...	828.45	82.68	475.72	16.27	

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Analyses of Milk.

	July 12.	July 22.	July 28.	Aug. 4.
Water,	88.15	87.30	87.40	87.92
Solids,	11.85	12.70	12.60	12.08
Fat (in solids),	3 28	3.14	3.48	3 20

Cost of Fodder Consumed during the 1st Feeding Period.

113¾ lbs. Gluten Meal,	$1 27
113¾ lbs. Shorts,	1 31
700 lbs. Hay,	5 25
Total, 927½ lbs.	$7 83

Daily produce of milk,	26.7 lbs., 13.36 qts.
Cost of daily fodder,	22.4 cents.
Cost of fodder per quart of milk,	1.68 cents.

Record of Melia — Continued.

FEEDING (2.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Aug. 5–12,	6½	3¼	18 4/7	14 4/7	13 3/7	28	25.50	777
12–19,	6½	3¼	19 3/7	15	13	28	26.33	782
19–26,	6½	3¼	15 6/7	13 3/7	13 6/7	27 1/7	23.10	795
26–Sept. 2,	6½	3¼	19 3/7	14	12 3/7	26 3/7	26.33	827½

Amount of Digestible Matter contained in the Feed consumed.

Amount of Fodder Consumed during the 2d Period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
182 lbs. Gluten Meal,	160.74	43.69	113.83	5.45	1 : 5.32
91 lbs. Shorts,	81.46	16.21	43.94	3.47	
517 lbs. Hay,	462.46	26.58	265.11	6.30	
Total,	704.66	86.48	422.88	15.22	

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Analysis of Milk, Aug. 11.

Water,	87.15
Solids,	12.85
Fat (in solids),	3.49

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal,	$2 04
91 lbs. Shorts,	1 05
517 lbs. Hay,	3 88
Total, 790 lbs.,	$6 97

Cost of fodder per day,	24.9 cents.
Average produce of milk per day,	27.36 lbs., 13.68 quarts.
Cost of fodder per quart of milk,	1 82 cents.

Record of Melia — Continued.

FEEDING (3.)	Feed Consumed (lbs.) per Day			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Sept. 2–9,	6½	6½	14⅜	14¼	12	26¼	24.50	784
9–16,	6½	6½	13⅝	12	10⅜	22⅜	23.97	815

Amount of Digestible Matter contained in the Food consumed.

Amount of Fodder consumed during the 3d Period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal,	80.37	21 85	56.92	2.73	1 : 4.42
91 lbs. Shorts,	81.56	16.21	43.94	3 47	
196 lbs. Hay,	175.32	10.08	100.30	2.39	
Total,	237.25	48.14	201.16	8.59	

Analysis of Milk, Sept. 10.

Water,	87.60
Solids,	12.40
Fat (in solids),	3.55

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Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal,	$1 02
91 lbs. Shorts,	1 05
196 lbs. Hay,	1 47
Total, 378 lbs.,	$3 54

Cost of fodder per day,	25.3 cents.
Average produce of milk per day,	24.3 lbs., 12.15 quarts.
Cost of fodder per quart of milk,	2.08 cents.

Record of Melia — Concluded.

FEEDING (4.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Sept. 16-23,	3¼	3¼	19.4	12.86	11	23.86	23.42	845
23 to Oct. 1,	3¼	3¼	20.0	13.36	12	25.36	23.97	790

Amount of Digestible Matter contained in the Food consumed.

Amount of Fodder consumed during the 4th Period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45.5 lbs. Gluten Meal,	40.18	10.93	28.46	1.37	1 : 6.25
45.5 lbs. Shorts,	40.73	8.11	21.97	1.73	
276 lbs. Hay,	246.88	14.19	141.41	3.36	
Total,	327.79	33 23	191.84	6.46	

Analyses of Milk.

	Sept. 17.	Sept. 30.
Water,	87.48	87.56
Solids,	12.52	12.44
Fat (in solids).	3.26	3.14

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Cost of Fodder consumed during the 4th Feeding Period.

45.5 lbs. Gluten Meal,	$0 51
45.5 lbs Shorts,	52
276 lbs. Hay,	2 07
Total, 367 lbs.,	$3 10

Cost of fodder per day, ... 22.14 cents.
Average production of milk per day, . . . 24.6 lbs., 12.32 quarts.
Cost of fodder per quart of milk, ... 1.8 cents.

II — Record of Nellie May.

Feeding (1.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
July 1–8,	3¼	3¼	20	9⅝	9⅜	19	23.97	925
8–15,	3¼	3¼	20	10	9½	19½	23.97	917
15–22,	3¼	3¼	20	10	9½	19½	23.97	900
22–29,	3¼	3¼	20	9⅝	8⅝	18⅜	23.97	892
29 to Aug. 5,	3¼	3¼	20	9⅝	8½	17⅝	23.97	937

Amount of Digestible Matter contained in the Food consumed.

Amount of Fodder consumed during the 1st Period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
113¾ lbs. Gluten Meal,	100.46	26.44	62.15	3.40	1 : 6.32
113¾ lbs. Shorts,	101.84	20.25	54.93	4.34	
700 lbs. Hay,	626.15	35.99	358.64	8.53	
Total,	828.45	82.68	475.72	16.27	

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Analyses of Milk.

	July 12.	July 22.	July 28.
Water,	87.11	86.73	86.49
Solids,	12.89	13.27	13.51
Fat (in solids),	3.86	3.61	4.01

Cost of Fodder consumed during the 1st Feeding Period.

113¾ lbs. Gluten Meal,	$1 27
113¾ lbs. Shorts,	1 31
700 lbs. Hay,	5 25
Total, 927½ lbs.,	$7 83

Daily produce of milk,	18.63 lbs., 931 quarts.
Cost of fodder per day,	22.4 cents.
Cost of fodder per quart of milk,	2.41 cents.

Record of Nellie May — Continued.

FEEDING (2.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Aug. 5–12,	6½	3¼	20	8 4/7	8	16 4/7	26.86	945
12–19,	6½	3¼	20	8 4/7	8	16 4/7	26.86	945
19–26,	6½	3¼	19 3/7	8	7	15	26.86	960
26 to Sept. 1,	6½	3¼	20	8 1/7	7 1/7	15 2/7	26.86	977

Amount of Digestible Matter contained in the Food consumed.

AMOUNT OF FODDER CONSUMED DURING THE 2D PERIOD.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
182 lbs. Gluten Meal,	160.74	43.69	113.83	5.45	1 : 5.15
91 lbs. Shorts,	81.46	16.21	43.94	3.47	
556 lbs. Hay,	497.34	28.59	284.86	6 78	
Total,	739.54	88.49	442.63	15.70	

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Analyses of Milk.

	Aug. 5.	Aug. 11.
Water,	86.77	86.75
Solids,	13.23	13.25
Fat (in solids),	4.01	4.06

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal,	$2 04
91 lbs. Shorts,	1 05
556 lbs. Hay,	4 17
Total, 829 lbs.,	$7 26

Cost of fodder per day, ... 25 93 cents.
Average produce of milk per day, . . 15.9 lbs., or 7 95 quarts.
Cost of fodder per quart of milk, ... 3.38 cents.

Record of Nellie May — Continued.

Feeding (2.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Sept. 2– 8,	6½	6½	19¼	8¼	7¾	15¾	28.95	955
8–15,	6½	6½	18¾	7¾	6¾	13¾	28.95	985

Amount of Digestible Matter contained in the Food consumed.

Amount of Fodder consumed during the 2d period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal,	80.37	21.85	56.92	2.73	1 : 5.1
91 lbs. Shorts,	81.56	16.21	43.94	3.47	
270 lbs. Hay,	239.52	13.88	139.27	3.29	
Total,	401.45	51.94	240.13	9.49	

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Analysis of Milk Sept. 10.

Water,	85.18
Solids,	14.82
Fat (in solids),	4.59

Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal,	$1 02
91 lbs. Shorts,	1 05
270 lbs. Hay,	2 03
Total, 452 lbs.	$4 10

Average produce of milk per day,	14.18 lbs., 7.09 quarts.
Cost of fodder per day,	29.3 cents.
Cost of fodder per quart of milk,	4.13 cents.

Record of Nellie May — Concluded.

FEEDING (4.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
Sept. 15-22,	3¼	3¼	17⅜	6⅐	5⅐	12⅐	21.67	1,002½
22-29,	3¼	3¼	20	6⅜	6⅜	14⅜	23.97	1,005

Amount of Digestible Matter contained in the Food consumed.

Amount of Fodder consumed during the 4th Period.	Total Dry Matter.	Digestible Matter.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45½ lbs. Gluten Meal,	40.18	10.93	28.46	1.37	1 : 6.11
45½ lbs. Shorts,	40.73	8.11	21.97	1.73	
274 lbs. Hay,	245.09	14.84	140.38	3.34	
Total,	326.00	33.88	190.81	6.44	

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Analysis of Milk.

	Sept. 17.	Sept. 30.
Water,	85.04	85.92
Solids,	14.96	14.08
Fat (in solids),	4.36	4.45

Cost of Fodder consumed during the 4th Feeding Period.

45½ lbs. Gluten Meal,	$0 51
45½ lbs. Shorts,	52
274 lbs. Hay,	2 06
Total, 365 lbs.,	$3 09

Average produce of milk per day,	13.46 lbs., 6.82 quarts.
Cost of fodder per day,	22.1 cents.
Cost of fodder per quart of milk,	3.25 cents.

III. — Record of Fairy.

Feeding (1.)	Feed Consumed (lbs.) per Day.			Milk Produced (lbs.) per Day.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
Weeks.								
July 1–8,	3¼	3¼	20	10¼	9¾	19⅞	23.97	907
8–15,	3¼	3¼	20	10⅞	10¼	21	23.97	927
15–22,	3¼	3¼	20	10⅞	10	20⅞	23.97	912½
22–29,	3¼	3¼	20	10⅜	9⅜	19¾	23.97	902
29–Aug. 4,	3¼	3¼	20	10¼	9	19¼	23.97	935

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Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 1st PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
113¾ lbs. Gluten Meal, .	100.46	26.44	62.15	3.40	1 : 6.32
113¾ lbs. Shorts, . .	101.84	20.25	54.93	4.34	
700 lbs. Hay, . . .	626.15	35.99	358.64	8.53	
Total, ...	828.45	82.68	475.72	16.27	

Analyses of Milk.

	July 12.	July 22.	July 28.	Aug. 4.
Water, ...	87.05	86.42	86.82	86.79
Solids, ...	12.95	13.58	13.18	13.21
Fat (in solids), ...	3.76	3.73	3.67	3.81

Cost of Fodder consumed during the 1st Feeding Period.

113¾ lbs. Gluten Meal, ...	$1 27
113¾ lbs. Shorts, ...	1 31
700 lbs. Hay, ...	5 25
Total, 927½ lbs., ...	$7 83

Average produce of milk per day, ... 20.1 lbs., 10 quarts.
Cost of fodder per day, ... 22.4 cents.
Cost of fodder per quart of milk, ... 2.24 cents.

Record of Fairy — Continued.

FEEDING (2.)	FED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Aug. 4–11, . .	6½	3¼	20	10⅗	9⅘	20	26.86	942
11–18, . .	6½	3¼	20	10⅗	9⅘	20⅗	26.86	952
18–25, . .	6½	3¼	19⅘	9⅘	9	18⅘	26.26	965
25–Sept. 1, .	6½	3¼	19⅘	10	8⅘	18⅘	26.67	1,027½

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Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 2D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates	Fat.	
182 lbs. Gluten Meal, .	160.74	43.69	113.83	5.45	1 : 5.45
91 lbs. Shorts, . . .	81.46	16.21	43.94	3.47	
554 lbs. Hay, . . .	495.55	28.48	283.83	6.75	
Total, ...	737.75	88.38	441.60	15.67	

Analysis of Milk, Sept. 11.

Water, ...	86.39
Solids, ...	13 61
Fat (in solids), ...	3.91

Cost of Fodder consumed during the 2d Feeding Period.

182 lbs. Gluten Meal, ...	$2 04
91 lbs. Shorts, ...	1 05
554 lbs. Hay, ...	3 79
Total, 827 lbs., ...	$6 88

Average produce of milk per day, ...	19.5 lbs., 9.75 quarts.
Cost of fodder per day, ...	24.6 cents.
Cost of fodder per quart of milk, ...	2.52 cents.

Record of Fairy — Continued.

FEEDING (3.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 1–8, . .	6½	6½	20	9 3/7	8 4/7	18	29.71	1,002½
8–15, . .	6½	6½	16 4/7	9 1/7	7 6/7	17	26.65	1.000

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Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 3D PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
91 lbs. Gluten Meal, .	80.37	21.85	56.92	2.73	1 : 4.36
91 lbs. Shorts, . .	81.56	16.21	43.49	3.47	
251 lbs. Hay, ...	224.52	12.90	128 59	3.06	
Total, ...	386.45	50.96	229 45	9.26	

Analysis of Milk Sept. 10.

Water, ...	85.60
Solids, ...	1.05
Fat (in solids), ...	1.88

Cost of Fodder consumed during the 3d Feeding Period.

91 lbs. Gluten Meal, ...	$1 02
91 lbs. Shorts	1 05
251 lbs. Hay, ...	1 88
Total, 433 lbs., ...	$3 95

Average produce of milk per day, ...	14.68 lbs., 7.34 quarts.
Cost of fodder per day, ...	28.2 cents.
Cost of fodder per quart of milk, ...	3.84 cents.

Record of Fairy— Concluded.

FEEDING (4.)	FEED CONSUMED (LBS.) PER DAY.			MILK PRODUCED (LBS.) PER DAY.			Amount of dry vegetable matter contained in the daily fodder consumed (lbs.).	Weight of Animal (lbs.).
	Gluten Meal.	Shorts.	English Hay.	Morning.	Evening.	Total.		
WEEKS.								
Sept. 15–22, . .	3¼	3¼	17⅝	9⅝	8⅝	18⅝	21.96	1,007½
22–29, . .	3¼	3¼	20	10	9	19	23.97	1,035

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Amount of Digestible Matter contained in the Fodder consumed.

AMOUNT OF FODDER CONSUMED DURING THE 4TH PERIOD.	Total Dry Matter.	DIGESTIBLE MATTER.			Nutritive Ratio.
		Protein.	Carb. Hydrates.	Fat.	
45½ lbs. Gluten Meal, .	40.18	10.93	28.46	1.37	1 : 6.21
45½ lbs. Shorts, . .	40.73	8.11	21.97	1.73	
269 lbs. Hay, ...	240.62	13.83	137.81	3.28	
Total, ...	321.53	32.87	188.24	6.38	

Analysis of Milk.

	Sept. 17.	Sept. 30.
Water, ...	85.85	85.99
Solids, ...	14.15	14.01
Fat (in solids), ...	4.06	4.11

Cost of Fodder Consumed during the 4th Feeding Period.

45½ lbs. Gluten Meal, ...	$0 51
45½ lbs. Shorts, ...	52
269 lbs. Hay, ...	2 02
Total, 360 lbs., ...	$3 05

Average produce of milk per day, . . . 18.9 lbs., 9.45 quarts.
Cost of fodder per day, ... 21.8 cents.
Cost of fodder per quart of milk, ... 2.31 cents.

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GLUTEN MEAL.

[From Chicago Sugar Refining Company.]

Eighty-five per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.68	233.6	–	–	1 : 2.92
Dry Matter,	88.32	1,766 4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.79	15.8	–	–	
" Cellulose,	0.77	15.4	5.24	34	
" Fat,	3.94	78.8	59.89	76	
" Protein (Nitrogenous Matter),	28.24	564.8	408.08	85	
Non-nitrogenous Extract Matter,	66.26	1,325.2	1,245.69	94	
	100.00	2,000.0	1,790.90	–	

The gluten meal is obtained as a by-product in the manufacture of starch and glucose from corn. It consists mainly of the germs of the latter, with more or less skin parts and starch. The supply of this substance has acquired considerable proportions in consequence of the recent development of the glucose industry in this country.

Examinations of samples from various sources have demonstrated its highly nitrogenous character, and left but little doubt about its value for feeding purposes under suitable circumstances. For details in this direction I refer, as far as my own observations and statements are concerned, to Bulletin I., page 11, and Bulletin V., page 5, or the First Annual Report. The variations noticed in composition are in the main evidently caused by modifications in the manufacturing process, — a circumstance by no means an exceptional one, as far as the gluten meal is concerned; for all our valuable refuse materials for fodder, as brans, oil-cakes, etc., suffer from the same influence. The sample which served for our feeding experiments, and furnished the ma-

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terial for the above analysis, was obtained by the following process, according to the kind communication of Dr. A. Behr, the superintendent of the Chicago Sugar Refining Company: "The process mostly followed in starch and glucose works for the separation of starch, includes the use of caustic-soda for dissolving the gluten (nitrogenous constituents of the corn). Our process differs in these particulars, that we do not use any caustic-soda at all, and that we separate the germs of the corn before it is finally ground up. The consequence is, that gluten meal contains no caustic-soda or sodium-salts, and is comparatively poor in fat, — this being for the greater part removed with the germs. The way we proceed is briefly as follows: The water as it comes from the mills and carries the fine starch and gluten in suspension, is run over long slightly inclined troughs, the ordinary "Starch-Tables." Here the heavy starch settles, while the lighter particles, small starch, gluten, fibre and fat are carried away with the water. This mixture is allowed to settle in large vats, the clear water drawn off, and the residue dumped into filter presses. The press cakes are dried in steam driers, ground up in mills, and in this form make the gluten meal."

The calculation of the digestible portion of the gluten-meal is based on that noticed in corn-meal, in actual feeding tests. The numerical relations between the digestible amount of nitrogenous constituents and of carbohydrates or non-nitrogenous constituents in the above sample of gluten meal (1:2.92), corresponds quite closely with that in a fair sample of pease; its mineral constituents are, however, but one-fifth of that of the latter.

The article is offered for sale by the carload in bulk at $21 per ton, or $22.50 in bags, at Boston railroad depots; similar charges have been made in Springfield.

The analyses of Wheat Bran and Timothy Hay, below stated, refer to the materials used in this experiment.

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WHEAT BRAN.

[From JOHN L. HOLLEY, South Amherst, Mass.]

13.71 per cent. passed through mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.48	209.6	–	–	1 : 8.25
Dry Matter,	89.52	1,790.4	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.98	139.6	–	–	
" Cellulose,	10.20	204.0	40.80	20	
" Fat,	4.77	95.4	76.32	80	
" Protein (Nitrogenous Matter,	20.24	404.8	356.22	88	
Non-nitrogenous Extract Matter,	57.81	1,156.2	924.96	80	
	100.00	2,000.0	1,398.3	–	

The article sold at $23 per ton at the mill.

TIMOTHY HAY.

[From the grounds of the Experiment Station, June 20, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.55	211.0	–	–	1 : 10.6
Dry Matter,	89.45	1,789.0	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.69	93.8	–	–	
" Cellulose,	29.21	584.2	338.84	58	
" Fat,	2.65	53.0	24.38	46	
" Protein (Nitrogenous Matter,	9.02	180.4	102.83	57	
Non-nitrogenous Extract Matter,	54.43	1,088.6	685.82	63	
	100.00	2,000.0	1,151.87	–	

The grass was cut at the close of the blooming period, and the hay is a fair article of its kind.

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SUMMARY OF THE INFLUENCE OF FEED ON THE COMPOSITION OF MILK.

NELLIE MAY.—Breed, grade Ayrshire; age, 4 years; dropped last calf Feb. 1, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk.			
			Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
April 8,	4 qts. Indian meal and hay all she would eat.	15 lbs.	87.57	12.43	3.71	8.72
11,		15 "	87.18	12.82	3.82	9.00
14,		15 "	87.09	12.91	3.87	9.04
16,	5½ lbs. meal and 15 lbs. hay, .	14 "	87.33	12.67	3.56	9.11
18,	6½ lbs. meal and 17 lbs. hay, .	14 "	87.65	12.35	3.97	8.38
21,		14 "	87.02	12.98	3.99	8.99
May 3,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	16 "	87.00	13.00	3.81	8.19
7,		16 "	87 09	12.91	3.91	9.00
12,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	15 "	87.43	12.57	3.86	8.71
20,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.39	12.61	3.80	8.81
22,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.19	12.81	3.68	9.13
23,	6½ lbs. meal, 8 lbs. hay and 50 lbs. ensilage.	15 "	87.37	12.63	3.68	8.95
June 16,	6½ lbs. meal, 8 lbs. hay 6½ lbs. shorts and 40 lbs. ensilage.	20 "	86.89	13.11	3.81	9.30
30,	6½ lbs. meal and 20 lbs. hay, .	18 "	87.20	12.80	3.83	8 97
July 12,	3½ lbs. wheat shorts, 3½ lbs. gluten meal and 20 lbs. hay.	19 "	87.11	12.89	3.86	9.03
22,		19 "	86.73	13.27	3.61	9.56
28,		18 "	86.49	13.51	4.01	9.50
Aug. 4,	3½ lbs. wheat shorts, 3½ lbs. gluten meal and 20 lbs. hay.	17½ "	86.77	13.23	4.01	9.22
11,	3½ lbs. wheat shorts, 6½ lbs. gluten meal and 20 lbs. hay.	17 "	86.75	13.25	4 06	9.19
Sept. 10,	6½ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	15 "	85.18	14.82	4.59	10.23
17,	3½ lbs. shorts, 3½ lbs. gluten meal and 20 lbs. hay.	12 "	85.04	14.96	4.36	10.60
30,		14 "	85.92	14.08	4.45	9.63

FAIRY.—Breed, grade Ayrshire; age, 5 years; dropped last calf Feb. 25, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk.			
			Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
April 8,	4 qts. meal and all hay animal would eat.	19 lbs.	87.46	12.54	3 33	9.21
11,		19 "	87.67	12.33	3.20	9.13
14,	4 qts. meal and all hay animal would eat.	19 "	87.54	12.46	3.34	9.12
16,	5½ lbs. meal and 15 lbs. hay, .	19 "	87.28	12.72	3.49	9.23
18,	6½ lbs. meal and 17 lbs. hay, .	19 "	87 92	12.08	3.32	8.76
21,	6½ lbs. meal and 17 lbs. hay, .	19 "	87.59	12.41	3.64	8.77
May 3,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	19 "	87.16	12.84	4 08	8.76
7,		19 "	86.99	13 01	3.88	9.13
12,	6½ lbs. meal, 8 lbs. hay and 40 lbs. ensilage.	19 "	86.84	13.16	3.93	9.13
20,	6½ lbs. meal, 7 lbs. hay and 60 lbs. ensilage.	19 "	87.33	12.67	3.60	9.07
23,		19 "	87.55	12.45	3.29	9.16
26,	6½ lbs. meal, 7 lbs. hay and 60 lbs. ensilage.	18½ "	87.57	12.43	3.37	9.06
June 10,	6½ lbs. corn meal, 6½ lbs. shorts, 7 lbs. hay and 60 lbs. ensilage.	20 "	87.10	12.90	3.61	9.29
16,		21 "	86.60	13.40	3.83	9.57
30,	6½ lbs. meal and 20 lbs. hay, .	20 "	87.36	12.64	3.59	9.05

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FAIRY — *Concluded.*

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk. Water.	Total Solids.	Fat.	Solids not Fat.
July 12,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	21 "	87.05	12.95	3.76	9.19
22,		21 "	86.42	13.58	3.73	9.85
Aug. 4,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	19 "	86.79	13.21	3.81	9.40
11,	3¼ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	21 "	86.39	13.61	3.91	9.70
Sept. 10,	6½ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	17 "	85.60	14.40	4.84	9 56
30,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	19 "	85.99	14.01	4.11	9.90

CLARA. — Breed, grade Ayrshire; age, 5 years; dropped last calf Feb. 25, 1884.

1884.						
April 8,	4 qts. meal and all the hay the animal would eat.	16 lbs.	88.04	11.96	3.27	8 69
11,		16 "	87.32	12.68	3.48	9.20
14,	4 qts. meal and all the hay the animal would eat.	16 "	87.39	12.61	3.56	9.05
18,	6½ lbs. meal and 15 lbs. hay, .	17 "	87.08	12.92	3 89	9.03
21,	6½ lbs. meal and 15 lbs. hay, .	16 "	87 37	12.63	3 73	8.90
May 3,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	15½ "	87 25	12.75	3.69	9.06
7,		15½ "	87.39	12.61	3.62	8.99
12,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	15 "	87.20	12.80	3.66	9.14
20,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	14 "	87.69	12.31	3.47	8.84
23,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	14 "	87.88	12.12	3.21	8.91
26,	6½ lbs. meal, 7 lbs. hay and 30 lbs. ensilage.	13 "	87.97	12.03	3.47	8.56

MELIA. — Breed, Ayrshire; age, 11 years; dropped last calf Feb. 15, 1884.

1884.						
June 16,	6½ lbs. meal, 6½ lbs. shorts, 5 lbs. hay and 60 lbs. ensilage.	28 lbs.	87.84	12.16	3.21	8.95
30,	6½ lbs. meal and 20 lbs. hay, .	23 "	88.29	11.71	2.99	8 72
July 12,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 "	88.15	11.85	3.28	8.57
22,		27 "	87.30	12.70	3.14	8 56
28,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 "	87.40	12.60	3.48	9.12
Aug. 4,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	27 "	87.92	12.08	3.20	8.88
11,	3¼ lbs. shorts, 6½ lbs. gluten meal and 20 lbs. hay.	29 "	87.15	12.85	3.49	9.36
Sept. 10,		24 "	87 60	12.40	3 55	8.85
17,	3¼ lbs. shorts, 3¼ lbs. gluten meal and 20 lbs. hay.	22 "	87.48	12.52	3.26	9.26
30,		25 "	87.56	12.44	3.14	9.30
Nov. 18,	3¼ lbs. shorts, 3¼ lbs. meal and 20 lbs. hay.	19 "	87.66	12.34	3.39	8.95
24,		19 "	87.88	12.22	3.48	8.74
Dec. 5,	3¼ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 15 lbs hay.	22 "	87.01	12.99	3.55	9 44
10,		22 "	87 27	12 73	3.49	9.24
17,		21 "	87.68	12.32	3 24	9.08
24,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	20 "	87.31	12.69	3.58	9.11
1885.						
Jan. 7,		16 "	87.49	12.51	3.66	8.85
15,	3¼ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	16 "	88.09	11.91	3.33	8.58

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BESSIE. — Breed, grade Jersey; age, 5 years; dropped last calf Oct. 17, 1884.

Year and Month.	Feed.	Daily Yield of Milk.	Composition of Milk.			
			Water.	Total Solids.	Fat.	Solids not Fat.
1884.						
Nov. 18,	3½ lbs. shorts, 3¼ lbs. meal and 16 lbs. hay.	29 lbs.	87.06	12.94	4.04	8.90
24,		21 "	87.91	13.09	3.86	9.13
Dec. 5,	3½ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 16 lbs. hay.	29 "	86.18	13.82	4.02	9.80
10,		29 "	86.99	13.01	3.72	9.29
17,	3½ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 16 lbs. hay.	28 "	87.41	12.59	3.32	9.27
24,	3½ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	27 "	85.36	14.64	4.75	9.89
1885.						
Jan. 7,	3½ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	24 "	87.26	12.74	3.73	9.01
15,	3½ lbs. shorts, 3¼ lbs. meal and 15 lbs. hay.	23 "	87.29	12.71	3.91	8.80

LADY HORACE.—Grade Ayrshire; age, 5 years; dropped last calf Oct. 16, 1884.

1884.						
Nov. 18,	3½ lbs. shorts, 3¼ lbs. meal and 16 lbs. hay.	29 lbs.	86 02	13 98	4.99	8.99
24,		28 "	87.15	12.85	3.65	9 20
Dec. 5,	3½ lbs. shorts, 3¼ lbs. meal, 3¼ lbs. gluten meal and 20 lbs. hay.	33 "	85.12	14.88	5.10	9.78
10,		34 "	87.20	12.80	3.74	9.06
17,		31 "	87 26	12.74	3.86	8.88
24,	3½ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	29 "	86.22	13 78	4.70	9.08
1885.						
Jan. 7,	3½ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	24 "	87.41	12.59	3.64	8.95
15,	3½ lbs. shorts, 3¼ lbs. meal and 19 lbs. hay.	24 "	87.05	12.95	3.95	9.00

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Observations with Milk.

I. *Influence of Temperature on Specific Gravity.*

Pure milk (Lady Horace): Water, 87.17 per cent.; solids, 12.83 per cent.; fat, 3.69 per cent.; solids not fat, 9.14 per cent.

Temperature,	8.5° C.	Sp. Gr.,	1 0350.	*Lactometer,	120.
"	11.5°	"	1.0344.	"	118.
"	14.°	"	1.0338.	"	116.
"	16.5°	"	1.0329.	"	113.
"	19.5°	"	1.0323.	"	111.
"	22.°	"	1.0317.	"	109.
"	24.°	"	1.0314.	"	108.
"	28.3°	"	1.0299.	"	103.
"	30.°	"	1.0293.	"	101.

Pure milk: Water, 87.26 per cent.; solids, 12.74 per cent.; fat, 3.89 per cent.; solids not fat, 8.85 per cent.

Temperature,	7.° C.	Sp. Gr.,	1.0353.	Lactometer,	121.
"	9.°	"	1.0353.	"	121.
"	10.°	"	1.0350.	"	120.
"	13.°	"	1.0338.	"	116.
"	14.°	"	1.0335.	"	115.
"	16.°	"	1.0332.	"	114.
"	17.°	"	1.0329.	"	113.
"	19.5°	"	1.0320.	"	110.
"	21.°	"	1.0314.	"	108.
"	23.°	"	1.0311.	"	107.

Pure milk: Water, 86.22 per cent.; solids, 13.78 per fat, 4.70 per cent.; solids not fat, 9.08 per cent.

Temperature,	3.° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
"	6.5°	"	1.0353.	"	121.
"	8.5°	"	1.0350.	"	120.
"	11.°	"	1.0347.	"	119.
"	13.5°	"	1.0340.	"	117.
"	16.2°	"	1.0329.	"	113.
"	19.8°	"	1.0320.	"	110.

* The lactometer used in these examinations is Mott's Lactometer, verified by Dr. H. A. Mott of New York City, N. Y.

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Pure milk: Water, 87.41 per cent.; solids, 12.59 per cent.; fat, 3.64 per cent.; solids not fat, 8.95 per cent.

Temperature,	11.5° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
"	13.6°	"	1.0350.	"	120.
"	16.°	"	1.0347.	"	119.
"	18.°	"	1.0341.	"	117.
"	18.5°	"	1.0338.	"	116.

Pure milk: Water, 87.05 per cent.; solids, 12.95 per cent.; fat, 3.95 per cent.; solids not fat, 3.00 per cent.

Temperature,	12.5° C.	Sp. Gr.,	1.0338.	Lactometer,	116.
"	15.°	"	1.0332.	"	114.

Pure milk (Bessie): Water, 86.99 per cent.; solids, 13.1 per cent.; fat, 3.72 per cent.; solids not fat 9.29 per cent.

Temperature,	9.° C.	Sp. Gr.,	1.0353.	Lactometer,	121.
"	11.°	"	1.0350.	"	120.
"	14.5°	"	1.0341.	"	117.
"	17.°	"	1.0335.	"	115.
"	19.5°	"	1.0332.	"	114.
"	21.4°	"	1.0323.	"	111.
"	24.9°	"	1.0311.	"	107.
"	27.5°	"	1.0299.	"	103.
"	30.°	"	1.0293.	"	101.

Water, 87.41 per cent.; solids, 12.59 per cent.; fat, 3.29 per cent.; solids not fat, 9.30 per cent.

Temperature,	5.° C.	Sp. Gr.,	1.0365.	Lactometer,	125.
"	8.5°	"	1.0362.	"	124.
"	9.°	"	1.0362.	"	124.
"	12.°	"	1.0353.	"	121.
"	16.°	"	1.0341.	"	117.
"	17.°	"	1.0341.	"	117.
"	20.°	"	1.0329.	"	113.
"	21.°	"	1.0326.	"	112.
"	23.5°	"	1.0317.	"	109.

Water, 85.33 per cent.; solids, 14.67 per cent.; fat, 4.75 per cent.; solids not fat, 9.92 per cent.

Temperature,	1.8° C.	Sp. Gr.,	1.0371.	Lactometer,	127.
"	6.5°	"	1.0365.	"	125.
"	9.°	"	1.0365.	"	125.
"	11.°	"	1.0362.	"	124.
"	13.5°	"	1.0356.	"	122.
"	16.5°	"	1.0344.	"	118.
"	19.5	"	1.0329.	"	113.

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Water, 87.27 per cent.; solids, 12.73 per cent.; fat, 3.73 per cent.; solids not fat, 9.00 per cent.

Temperature,	11.5° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
"	14.9°	"	1.0350.	"	120.
"	16.5°	"	1.0344.	"	118.
"	18.°	"	1.0341.	"	117.

Water, 87.32 per cent.; solids, 12.68 per cent.; fat, 3.91 per cent.; solids not fat, 8.77 per cent.

Temperature,	13.5° C.	Sp. Gr.,	1.0335.	Lactometer,	115.
"	15.°	"	1.0335.	"	115.

Pure milk (Melia): Water, 87.27 per cent.; solids, 12.73 per cent.; fat, 3.49 per cent.; solids not fat, 9.24 per cent.

Temperature,	9.° C.	Sp. Gr.,	1.0341.	Lactometer,	117.
"	11.° C.	"	1.0338.	"	116.
"	14.8°	"	1.0332.	"	114.
"	18.°	"	1.0323.	"	111.
"	20.5°	"	1.0320.	"	110.
"	22.°	"	1.0320	"	110.
"	25.°	"	1,0308.	"	106.
"	27.°	"	1.0302.	"	104.
"	29.5°	"	1.0293.	"	101.

Water, 87.67 per cent.; solids, 12.33 per cent.; fat, 3.24 per cent.; solids not fat, 9.09 per cent.

Temperature,	5.° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
"	8.8°	"	1.0353.	"	121.
"	12.°	"	1.0341.	"	117.
"	14.°	"	1.0335.	"	115.
"	15.5°	"	1.0332.	"	114.
"	17.°	"	1.0329.	"	113.
"	19.5°	"	1.0317.	"	109.
"	20.5°	"	1.0314.	"	108.

Water, 87.31 per cent.; solids, 12.69 per cent.; fat, 3.57 per cent.; solids not fat, 9.12 per cent.

Temperature,	0.5° C.	Sp. Gr.,	1.0356.	Lactometer,	122.
"	5.5°	"	1.0353.	"	121.
"	8.°	"	1.0350.	"	120
"	10.°	"	1.0350.	"	120.
"	12.5°	"	1.0341.	"	117.
"	15.5°	"	1,0332.	"	114.
"	19.°	"	1.0317.	"	109.

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Water, 87.32; per cent.; solids, 12.68 per cent; fat, 3.66 per cent.; solids not fat, 9.02 per cent.

Temperature,	12.° C.	Sp. Gr.,	1.0332.	Lactometer,	114.
"	14.°	"	1.0329.	"	113.
"	16.5°	"	1.0326.	"	112.
"	17.7°	"	1.0323.	"	111.

Water, 88.07 per cent.; solids, 11.93 per cent.; fat, 3.33 per cent.; solids not fat, 8.60 per cent.

Temperature,	13.° C.	Sp. Gr.,	1.0311.	Lactometer,	107.
"	15.°	"	1.0311.	"	107.

Mixed Milk from Several Cows.

I. Water, 87.50 per cent.; solids, 12.50 per cent.; fat, 3.43 per cent.; solids not fat, 9.07 per cent.

Temperature,	12.° C.	Sp. Gr.,	1.0350.	Lactometer,	120.
"	14.5°	"	1.0347.	"	119.
"	15.5°	"	1.0344.	"	118.
"	17.°	"	1.0338.	"	116.
"	18.°	"	1.0335.	"	115.

II. Water, 85.70 per cent.; solids, 14.30 per cent.; fat, 4.90 per cent,; solids not fat, 9.40 per cent.

Temperature,	12.° C.	Sp. Gr.,	1.0362.	Lactometer,	124.
"	14.°	"	1.0355.	"	122.
"	16.°	"	1.0345.	"	118.
"	17.°	"	1.0335.	"	115.
"	19.°	"	1.0329.	"	113.
"	22.°	"	1.0323.	"	111.
"	27.°	"	1.0305.	"	105.

III. Water, 86.50 per cent; solids, 13.50 per cent.; fat, 3.88 per cent.; solids not fat, 9.62 per cent.

Temperature,	11.7° C.	Sp. Gr.,	1.0365.	Lactometer,	125.
"	13.°	"	1.0359.	"	123.
"	14.°	"	1.0353.	"	121.
"	15.°	"	1.0350.	"	120.
"	16.	"	1.0347.	"	119.
"	18.°	"	1.0343.	"	118.
"	19.2°	"	1.0340.	"	117.
"	20.°	"	1.0338.	"	116.
"	21.°	"	1.0330.	"	114.
"	21.5°	"	1.0330.	"	114.

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IV. Water, 85.90 per cent.; solids, 14.10 per cent.; fat, 4.65 per cent.; solids not fat, 9.45 per cent.

Temperature,	11.° C.	Sp. Gr.,	1.0362.	Lactometer,	124.
"	13.°	"	1.0353.	"	121.
"	15.°	"	1.0347.	"	119.
"	16.5°	"	1.0343.	"	118.
"	19.°	"	1.0332.	"	114.
"	21.°	"	1.0328.	"	113.
"	22.°	"	1.0323.	"	111.
"	25.°	"	1.0317.	"	109.

V. Water, 86.34 per cent.; solids, 13.66 per cent.; fat, 3.93 per cent.; solids not fat, 9.73 per cent.

Temperature,	11.° C.	Sp. Gr.,	1.0371.	Lactometer,	127.
"	13.5°	"	1.0371.	"	127.
"	15.°	"	1.0362.	"	124.
"	16.5°	"	1.0356.	"	122.
"	18.°	"	1.0353.	"	121.
"	21.°	"	1.0341.	"	117.
"	23.°	"	1.0335.	"	115.
"	25.°	"	1.0326.	"	112.

VI. Water, 84.87 per cent.; solids, 15.13 per cent.; fat, 5.49 per cent.; solids not fat, 9.64 per cent.

Temperature,	11.° C.	Sp. Gr.,	1.0359.	Lactometer,	123.
"	13.°	"	1.0350.	"	120.
"	14.5°	"	1.0347.	"	119.
"	17.°	"	1.0338.	"	116.
"	18.5°	"	1.0338.	"	116.

PURE MILK (MASSACHUSETTS AGRICULTURAL COLLEGE).

Temperature,	21.° C.	Sp. Gr.,	1.032.	Lactometer,	110.
"	14.°	"	1.033.	"	114.
"	10.°	"	1.035.	"	120.
"	7.°	"	1.0355.	"	122.

Increasing temperature of same: —

Temperature,	14.° C.	Sp. Gr.,	1.0345.	Lactometer,	116.
"	19.°	"	1.0330.	"	114.
"	21.°	"	1.0325.	"	112.

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II. *Influence of Water on the Composition of Milk.*

Milk from Lady Horace: Water, 87.05 per cent.; solids, 12.95 per cent.; fat, 3.95 per cent.; solids not fat, 9.00 per cent.

Added water until the lactometer stood at 100 at 15° C., or 14.5 per cent.

Water,	88.89	per cent.
Solids,	11.11	"
Fat (in solids),	3.31	"
Solids not fat,	7.80	"

Milk from Bessie: Water, 87.29 per cent.; solids, 12.71 per cent.; fat, 3.91 per cent.; solids not fat, 8.80 per cent.

Added water until the lactometer stood at 100 at 15° C., or 15.4 per cent.

Water,	89.03	per cent.
Solids,	10.97	"
Fat (in solids),	3.31	"
Solids not fat,	7.66	"

Milk from Melia: Water, 88.09 per cent.; solids, 11.91 per cent.; fat, 3.33 per cent.; solids not fat, 7.58 per cent.

Added water until the lactometer stood at 100 at 15° C., or 8.7 per cent.

Water,	88.91	per cent.
Solids,	11.09	"
Fat,	3.12	"
Solids not fat,	7.97	"

Pure milk — 1.032 specific gravity at 21° C., 110° lactometer.

3¾	per cent.	of water	added	21.° C.	1.0315	Sp. Gr.,	or 108	Lactometer.
6¾	"	"	"	21.°	1.030	"	104	"
10	"	"	"	21.°	1.029	"	100	"
16¾	"	"	"	21.°	1.027	"	94	"

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III. *Influence of Skimming on the Specific Gravity of Milk.*

Fresh genuine milk stood at —

23.° C.	1.0300	Sp. Gr., or	104	Lactometer.
19.°	1.0315	"	108	"
14.°	1.0320	"	110	"

After skimming: —

9.° C.	1.0360	Sp. Gr., or	124	Lactometer.
18.°	1.0350	"	120	"
23.°	1.0350	"	120	"

3. Notes on Feeding Experiments with Pigs.

The experiment described in a few subsequent pages is the first of a series planned for the purpose of studying the comparative feeding value of skim-milk and of creamery buttermilk, in connection with corn meal for the production of pork. To secure a suitable basis for the work, it was decided to ascertain first the facts regarding the results of feeding equal measures of skim-milk and of buttermilk, with a corresponding weight of corn meal in both cases. The skim-milk was obtained from the dairy of the college and the station; the buttermilk from the factory of the Amherst Co-operative Creamery Association. The skim-milk was rated at two cents per gallon, and the creamery buttermilk 1.37 cents per gallon, — the contractor's price. Corn meal was bought at $28 per ton. Several analyses of both kinds of milk, and the mean of three analyses of the corn meal fed during the experiment, are stated further on.

The skim-milk contained about 2.5 per cent. more solid matter than the creamery buttermilk, a circumstance due, most likely, to the access of some water from the first washing of the butter.

Six pigs, from forty to fifty pounds in weight (Berkshires), secured from the college farm, were used for the experiment; three of them were fed with skim-milk and corn meal (Lot A), and three with creamery buttermilk and corn meal (Lot B). Each of the two lots consisted of one barrow and

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two sows; the former (III.) gave in both lots the best results. The animals were fed alike, in the following way:—One-third of the daily ration of milk was fed with one-half of the daily ration of corn meal at six o'clock, A. M.; one-third of the milk at twelve o'clock, M., without any meal; and the remaining third part of milk with one-half of the meal at six o'clock, P. M. Whenever the previous feed was consumed some hours before a succeeding feeding time, the amount of daily fodder was gradually increased. This rule of feeding was carried out during the entire trial and suffered only a temporary modification in consequence of a few short periods of very hot weather.

At the beginning of the experiment about two ounces of corn meal were fed for every quart of milk, and subsequently three ounces for every quart. This proportion of corn meal to milk produced better results in the case of buttermilk (Lot B) than in the case of skim-milk (Lot A), considering the larger amount of solid matter contained in the latter.

Nearly one-fourth of the solid matter noticed in the skim-milk shows no return of a proportionate increase in live weight, as will be found on comparing the subsequent detailed record. The total live weight and dressed weight of both lots of animals differ only two to four pounds from each other,—the buttermilk leading. The cost of fodder per pound of dressed pork produced, amounts in Lot A (skim-milk) to 5.8 cents, and in case of Lot B (buttermilk) to 4.6 cents.

This difference in cost corresponds quite closely with the difference in cost of the two kinds of milk. The dressed pork was sold at 7½ cents per pound. The value of manure produced will be reported on some later occasion, when actual values can be presented.

The investigation is continued. Two breeds—Berkshire and Chester—are already on trial to turn to account the information received in the first experiment.

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[A.]

SKIM-MILK AND CORN MEAL.

I.

PERIODS.	Feed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts.)		
May 21–31,	100	58	41½	0 lbs. 11 ozs.
June 1–9,	132	54	60½	1 " 0 "
9–17,	128	48	67	0 " 15 "
17–24,	152	50	79¾	1 " 13 "
24–30,	160	54	89¾	1 " 7 "
July 1–7,	210	70	101	1 " 10 "
7–14,	210	70	111½	1 " 8 "
14–22,	288	96	124½	1 " 14 "
22–29,	252	84	140¼	2 " 4 "
29–Aug. 5,	228	76	147¼	1 " 0 "
Aug. 5–12,	180	60	156½	1 " 5 "
12–19,	252	84	170	1 " 15 "
19–26,	252	84	183½	1 " 15 "
26–Sept. 2,	258	86	188½	0 " 11 "
Sept. 2–9,	231	77	202¼	2 " 0 "
9–16,	294	98	217¼	2 " 2¾ "
16–22,	210	70	228¾	1 " 15 "

Total amount of feed consumed from May 21 to Sept. 22, 1884, —

221 lbs. Corn Meal, equal to dry matter,	189.57 lbs.
1,219 qts. Skim-milk, equal to dry matter,	255 45 lbs.
Total amount of dry matter,	454.02 lbs.

Live weight of animal at beginning of experiment,	44.75 lbs.
Live weight at time of killing,	228.75 lbs.
Live weight gained during experiment,	184. lbs.
Dressed weight at time of killing,	181.75 lbs.
Loss in weight by dressing,	47 lbs., or 20.5 per cent.
Dressed weight gained during experiment,	146. lbs.

Cost of feed consumed during the experiment, —

221 lbs. Corn Meal, at 1.4 cents,	$3 09
305 gals. Skim-milk, at 2 cents per gal.,	6 10
	$9 19

454 lbs. of dry matter fed, produced 184 lbs. of live weight, and 146 lbs. of dressed weight. 2.47 of dry matter yielded 1 lb. live weight; and 3.11 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 6.3 cents.

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[A.]

SKIM-MILK AND CORN MEAL — Continued.

II.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts.)		
May 21-31,	100	58	54½	0 lbs. 12 ozs.
June 1-9,	132	54	77	1 " 11 "
9-17,	192	64	87½	1 " 7 "
17-24,	152	50	97¾	1 " 8 "
24-30,	160	54	109	1 " 10 "
July 1-7,	210	70	121½	1 " 12 "
7-14,	210	70	130¾	1 " 6 "
14-22,	288	96	141¼	1 " 9 "
22-29,	252	84	154¾	1 " 13 "
29-Aug. 5,	228	76	162¾	1 " 3 "
Aug. 5-12,	180	60	167¼	0 " 10 "
12-19,	252	84	179	1 " 11 "
19-26,	252	84	190¾	1 " 11 "
26-Sept. 2,	258	86	193¼	0 " 7 "
Sept. 2-9,	294	98	211¼	2 " 8 "
9-16,	294	98	221¼	1 " 8 "
16-22,	210	70	230¼	1 " 7 "

Total amount of feed consumed from May 21 to Sept. 22, —

226½ lbs. Corn Meal, equal to dry matter,	197.92 lbs.
1,256 qts. Skim-milk, equal to dry matter,	263.21 lbs.
Total amount of dry matter,	461.13 lbs.

Live weight of animal at beginning of experiment,	54.50 lbs.
Live weight at time of killing,	230.25 lbs.
Live weight gained during experiment,	175.75 lbs.
Dressed weight at time of killing,	195. lbs.
Loss in weight by dressing,	35.25 lbs., or 15.3 per cent.
Dressed weight gained during experiment,	148.84 lbs.

Cost of feed consumed during the experiment, —

226½ lbs. Corn Meal, at 1.4 cents per lb.,	$3 17
314 gals. Skim-milk, at 2 cents per gal.,	6 28
	$9 45

461 lbs. of dry matter fed, produced 175.75 lbs. of live weight; and 148.84 lbs. of dressed weight. 263 lbs. of dry matter yielded 1 lb. live weight; and 3.08 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of pork, 6.4 cents.

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[A.]

SKIM MILK AND CORN MEAL — Concluded.

III.

PERIODS.	FEED CONSUMED.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Skim-milk (qts.)		
May 21–31,	100	58	50½	0 lbs. 15 ozs.
June 1–9,	132	54	74½	1 " 12 "
9–17,	192	64	85¾	1 " 10 "
17–24,	195	65	97¼	1 " 11 "
24–30,	195	65	114	2 " 5 "
July 1–7,	210	70	127¼	1 " 14 "
7–14,	252	84	145¼	2 " 9 "
14–22,	294	98	163	2 " 8 "
22–29,	294	98	181	2 " 9 "
29–Aug. 5,	294	98	200½	2 " 13 "
Aug. 5–12,	294	98	214½	1 " 15 "
12–19,	294	98	236	3 " 1 "
19–26,	294	98	250½	2 " 1 "
26–Sept. 2,	300	100	257½	1 " 0 "
Sept. 2–9,	336	112	281½	3 " 9 "
9–16,	336	112	293¾	1 " 12 "
16–22,	240	80	308½	2 " 7 "

Total amount of feed consumed from May 21 to Sept. 22, —

265¾ lbs. Corn Meal, equal to dry matter,	231.78 lbs.
1,452 qts. Skim-milk, equal to dry matter,	304.29 lbs.
Total amount of dry matter,	536.07 lbs.

Live weight at beginning of experiment,	50.50 lbs.
Live weight at time of killing,	308.50 lbs.
Live weight gained during experiment,	258. lbs.
Dressed weight at time of killing,	257.25 lbs.
Loss in weight by dressing,	51.25 lbs., or 16.64 per cent.
Dressed weight gained during experiment,	215.15 lbs.

Cost of feed consumed during experiment, —

265¾ lbs. Corn Meal, at 1.4 cents per lb.,	$3 72
363 gals. Skim-milk, at 2 cents per gal.,	7 26
	$10 98

536 lbs. of dry matter fed, produced 258 lbs. of live weight, and 215.15 lbs. dressed weight. 2.8 lbs. of dry matter yielded 1 lb. of live weight; and 2.5 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of pork, 5.11 cents.

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[B]

BUTTERMILK AND CORN MEAL.

I.

PERIODS.	Feed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
May 21–31,	100	58	48¼	0 lbs. 11 ozs.
June 1–9,	132	54	66	1 " 6 "
9–17,	192	64	77½	1 " 7 "
17–24,	152	50	87½	1 " 7 "
24–30,	160	54	98¼	1 " 9 "
July 1–7,	210	70	107¾	1 " 5 "
7–14,	210	70	120¾	1 " 14 "
14–22,	288	96	131½	1 " 8 "
22–29,	252	84	143¾	1 " 12 "
29–Aug. 5,	192	68	153¾	1 " 7 "
Aug. 5–12,	168	56	160¾	1 " 0 "
12–19,	252	84	172½	1 " 11 "
19–26,	252	84	183¼	1 " 8 "
26–Sept. 2,	258	86	185	0 " 4 "
Sept. 2–9,	294	98	206¼	3 " 0 "
9–16,	294	98	219¾	1 " 14 "
16–22,	294	70	230½	1 " 14 "

Total amount of feed consumed from May 21 to Sept. 22, —

226 lbs. Corn Meal, equal to dry matter,	197.48 lbs.
1,244 qts. Buttermilk, equal to dry matter,	190.33 lbs.
Total amount of dry matter,	387.81 lbs.

Live weight of animal at beginning of experiment,	48.25 lbs.
Live weight at time of killing,	230.50 lbs.
Live weight gained during the experiment,	182.25 lbs.
Dressed weight at time of killing,	190.75 lbs.
Loss in weight by dressing,	39.75 lbs., or 17.3 per cent.
Dressed weight gained during experiment,	150.85 lbs.

Cost of fodder consumed during experiment, —

226 lbs. Corn Meal, at 1.4 cents per lb.,	$3 16
311 gals. Buttermilk, at 1.37 cents per gal.,	4 26
	$7 42

387.8 lbs. of dry matter fed, produced 182.25 lbs. of live weight, and 150.85 lbs. of dressed weight. 2.12 lbs. of dry matter yielded 1 lb. of live weight; and 2.57 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of pork, 4.92 cents.

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[B.]

BUTTERMILK AND CORN MEAL — Continued.

II.

PERIODS.	Fed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
May 21–31,	100	58	45½	0 lbs. 12 ozs.
June 1–9,	132	54	67½	1 " 7 "
9–17,	192	64	79½	1 " 11 "
17–24,	152	50	89¾	1 " 6 "
24–30,	160	54	100	1 " 7 "
July 1–7,	210	70	111	1 " 9 "
7–14,	210	70	123¾	1 " 3 "
14–22,	288	96	135½	1 " 11 "
22–29,	252	84	147¼	1 " 11 "
29–Aug. 5,	192	68	158	1 " 8 "
Aug. 5–12,	168	56	163¾	0 " 13 "
12–19,	252	84	177	1 " 14 "
19–26,	252	84	189½	1 " 12 "
26–Sept. 2,	258	86	189	0 " 1½ "
Sept. 2–9,	294	98	211¾	8 " 4 "
9–16,	294	98	226¼	2 " 1 "
16–22,	210	70	238	1 " 15 "

Total amount of feed consumed from May 21 to Sept. 22, —

226 lbs. Corn Meal, equal to dry matter,	197.48 lbs.
1,244 qts. Buttermilk, equal to dry matter,	190.33 lbs.
Total amount of dry matter,	387.81 lbs.

Live weight of animal at beginning of experiment,	45.50 lbs.
Live weight at time of killing,	238. lbs.
Live weight gained during experiment,	192.50 lbs.
Dressed weight at time of killing,	199.25 lbs.
Loss in weight by dressing,	38.75 lbs., or 16.3 per cent.
Dressed weight gained during experiment,	161.2 lbs.

Cost of feed consumed during the experiment, —

226 lbs. Corn Meal, at 1.4 cents per lb.,	$3 16
311 gals. Buttermilk, at 1.37 cents per gal.,	4 26
	$7 42

387.8 lbs. of dry matter fed, produced 192.50 lbs live weight, and 161.2 lbs. dressed weight. 2.01 lbs. dry matter yielded 1 lb. of live weight; and 2.4 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb of pork, 4.64 cents.

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[B.]

TTERMILK AND CORN MEAL — Concluded.

III.

ODS.	Feed Consumed.		Weight of Animal (lbs.)	Daily Increase in Live Weight.
	Meal (ozs.)	Buttermilk (qts.)		
. . .	100	58	49	0 lbs. 11 ozs.
. . .	132	54	72	1 " 10 "
. . .	192	64	85¼	1 " 14 "
. . .	195	65	98	1 " 13 "
. . .	195	65	109½	1 " 10 "
. . .	210	70	121¾	1 " 12 "
. . .	252	84	133¼	1 " 10 "
. . .	294	98	151½	2 " 10 "
. . .	294	98	167	2 " 3 "
. . .	294	98	186¼	2 " 12 "
. . .	294	98	199¾	1 " 15 "
. . .	294	98	218¼	2 " 11 "
. . .	294	98	227¾	1 " 5 "
. . .	300	100	233½	0 " 13 "
. . .	336	112	259	3 " 11 "
. . .	336	112	281	3 " 2 "
. . .	240	80	293¼	2 " 1 "

feed consumed from May 21 to Sept. 22, —

Meal, equal to dry matter, ...	232.21 lbs.
rmilk, equal to dry matter, ...	222.16 lbs.
of dry matter, ...	454.37 lbs.

nimal at beginning of experiment, . .	49 lbs.
me of killing, ...	293¼ lbs.
ed during experiment, ...	244¼ lbs.
t time of killing, ...	243 lbs.
y dressing, ...	50 lbs., or 17 per cent.
gained during experiment, ...	202.3 lbs.

onsumed during the experiment, —

eal at 1.4 cents per lb., ...	$3 72
milk, at 1.37 cents per gal., ...	4 98
	$8 70

dry matter fed, produced 244¼ lbs. of live weight, and
l weight. 1.86 lbs. of dry matter yielded 1 lb. of live
3 lbs. of dry matter yielded 1 lb. of dressed weight.
r production of 1 lb. of pork, 4.3 cents.

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Summary of Results of Experiments.

A.—Pigs Fed with Skim-milk and Corn Meal.

	Corn Meal, in Pounds.	Skim-milk, in Gallons.	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.
I., ...	221	305	184	146
II., ...	226½	314	175¾	148⅝
III., ...	265¾	363	258	215½
	713¼	982	617¾	510

B.—Pigs Fed with Creamery Buttermilk and Corn Meal.

	Corn Meal, in Pounds.	Buttermilk, in Gallons.	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.
I., ...	226	311	182¼	150 9/16
II., ...	226	311	192½	161 3/16
III., ...	265¾	363	244¼	202 3/16
	717¾	985	619	514 1/16

Total Cost of Feed consumed during the Experiment.

A.	713¼ lbs. Corn Meal, ...		$9 98
	982 gals. Skim-milk, ...		19 64
			$29 62
B.	717¾ lbs. Corn Meal, ...		$10 04
	985 gals. Buttermilk, ...		13 50
			$23 54

Cost of Feed per Pound of Dressed Pork produced.

A.	Skim-milk and Meal, ...	5.8 cents.
B.	Buttermilk and Meal, ...	4.6 cents.

The difference in cost is approximately equal to the difference in cost of the buttermilk and skim-milk.

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Analyses of Milk used in the Experiment.

SKIM-MILK.

rom the College and Experiment Station Farms.]

	I.	II.	III.	Mean.
. .	90.20	90.42	90.64	90.42
. .	9.80	9.58	9.36	9.58
. .	.68	.32	.18	.39
nous mat- , . .	–	3.23	–	3.23

Nutritive Ratio, 1 : 2.15.

yses represent the kind of skim-milk fed during y described feeding experiment. One quart ounces and contained 3.35 ounces of solid er.

BUTTERMILK.

m the Amherst Co-operative Creamery Association.]

	I.	II.	III.	Mean.
. .	92.79	92.76	93.17	90.90
. .	7.21	7.25	6.83	7.09
. .	.20	.22	–	.21
nous mat- , . .	–	2.90	–	2.90

Nutritive Ratio, 1 : 1.63.

lyses were made at the same date when the sts were carried out, and represent, as far as the quality of buttermilk fed during the above- ding trial.

of buttermilk weighed 34 ounces and con- unces of solid matter (dried).

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CORN MEAL.

[92.34 per cent. passed through mesh 144 to the square inch.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.4	–	–	1 : 8.68
Dry Matter,	87.38	1,747.6	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.2	–	–	
" Cellulose,	2.65	53.0	18.06	34	
" Fat,	4.27	85.4	64.90	76	
" Protein (Nitrogenous Matter),	11.43	228.6	194.31	85	
Non-nitrogenous Extract Matter,	80.09	1,601.8	1,505.69	94	
	100.00	2,000.0	1,782.96	–	

This article represents the average composition of the corn meal fed in connection with skim-milk and buttermilk in the feeding experiments with pigs, described in the previous pages.

WHEAT BRAN.

[From John L. Holley, South Amherst, Mass.; 13.71 per cent. passed through mesh 144 to the square inch.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.48	209.6	–	–	1 : 3.25
Dry Matter,	89.52	1,790.4	–	–	
	100.00	2,000.0	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.98	139.6			
" Cellulose,	10.20	204.0	40.80	20	
" Fat,	4.77	95.4	76.32	80	
" Protein (Nitrogenous Matter),	20.24	404.8	356.22	88	
Non-nitrogenous Extract Matter,	57.81	1,156.2	924.96	80	
	100.00	2,000.0	1,398.30	–	

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ran of the previous table sold at $23 at the
ality of wheat bran was fed during the gluten-
xperiment with milch cows.

TIMOTHY HAY.

grounds of the Experiment Station, June 20, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	10.55	211.0	–	–	1 : 10.6
. . .	89.45	1,789.0	–	–	
	100.00	2,000.0	–	–	
y Matter.					
. . .	4.69	93.8	–	–	
. . .	29.21	584.2	338.84	58	
. . .	2.65	53.0	24.38	46	
Nitrogenous					
. . .	9.02	180.4	102.83	57	
Extract					
. . .	54.43	1,088.6	685.82	63	
	100.00	2,000.0	1,151.87	–	

s cut at the close of the blooming period, and
ir article of its kind. It served during the
ding experiment with milch cows.

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FIELD EXPERIMENTS.

The Experiment Station has entered already, in its firs year of existence, upon a systematic course of experiment to assist in determining the influence, mode of cultivation of system of manuring, and of stage of growth, on th comparative feeding value of some of our prominent farm crops.

The results thus far published, although essentially o local interest, deserve more than a passing notice, on accoun of the scarcity of examinations of a similar character o forage crops raised under quite common circumstances withi the limits of the State.

The significance of the various analytical results will become more apparent as the work progresses.

As the character of our soil, and its particular state of fertility, ought to be better known before a more detailed discussion of the connection between soil, season and compositio of the crop can be considered profitable, a mere record o the progress of the analytical work is all that can be consistently published at the present stage of the investigation.

Aside from the trials with some of our standard forag crops, there have been also inaugurated experiments wit the cultivation of reputed forage crops of other localitie and countries, to test their adaptability to our soil an climate. The successful introduction of a greater variety o valuable fodder crops, promises to furnish a wider range o fodder-substances, as far as their relative, as well as absolute nutritive value is concerned, a circumstance not less acceptable to our agricultural industry than it has proved elsewhere. The best interests of the dairy business call for a efficient protection against a serious periodical influence o drought on the yield of meadows and pastures. The cultivation of fodder crops, growing upon different kinds of soil

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different periods of the season, have proved tance in that direction. Some of the results cow pea, serradella, vetch, common lucerne ucerne, horse bean, lupine and pearl millet, within a few subsequent pages. This record rk in this direction makes no other claim ominently introduce the subject.

N (WITHOUT MANURE), UPON UNDERDRAINED PLATS.

[See Sketch A, p. 408.]

nual report of the station has been described es, the underdraining of a piece of land, one an acre in size, subdivided into eleven plats. designed to serve for an examination into rious manurial substances on the growth of influence on the character of the drainage l from the drains, under a different treat-

analysis of the first water running from the ferent plats after a rainfall May 22, 1883, d in the above-mentioned connection; and er of the soil, cultivation of the cornfield, ld of corn and of stalks.

s applied that year. It was desirable, in the articular experiments hereafter to be carried eld, that its latent resources of plant-food as practicable, exhausted, with reference to s for the production of Indian Corn.

ast season the field has been planted again rn fodder, without the application of manure on. The soil received a thorough mechani- by ploughing and harrowing, and the corn) was planted in drills, two and one-half feet e of two bushels per acre, on the 24th of re area was ploughed lengthwise, and thus The crop was kept clean from weeds by e cultivator. The plants started well in the n soon to fall behind, in general appearance, rnfields in the vicinity, upon fertilized lands.

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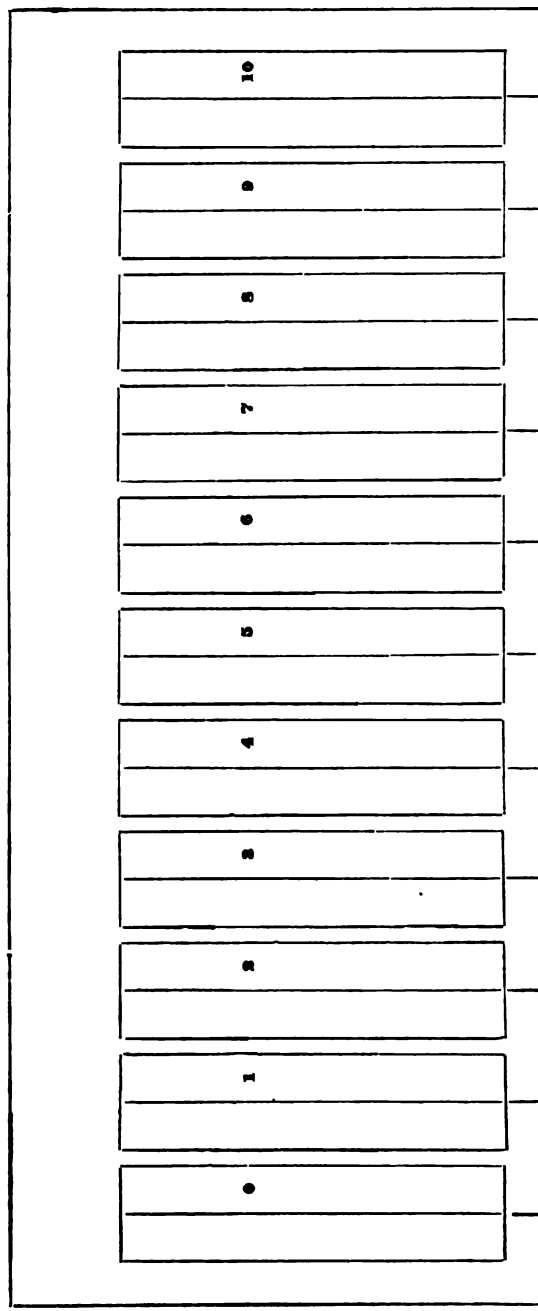
SKETCH "A."



Corn Plats with Drainage System. Scale, 4 rods to 1 inch.

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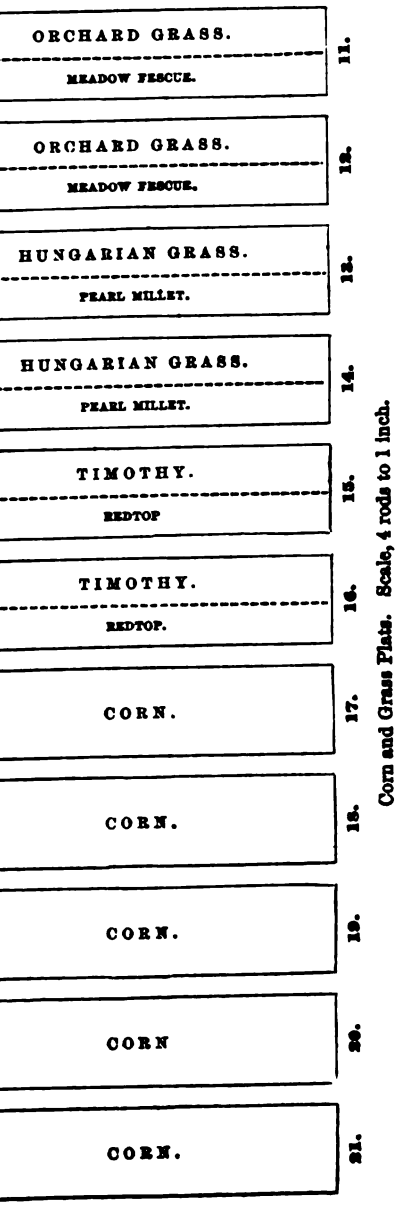
SKETCH "B."



Corn and Grass Plats. Scale, 4 rods to 1 inch.

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At the beginning of blooming it turned gradually yellow failed to produce grain-bearing cobs, and suffered, towar the end of the month of August, seriously, from smut.

The corn was cut on the first of September and stacke in the field for drying. The entire yield of corn fodde from this piece of land, one and one-tenth of an acre i size, amounted to 5,040 pounds, with a moisture of thirt per cent.

The soil is evidently in suitable condition for studying th special effects of various forms and kinds of plant food o the corn during the coming season.

It is worthy to notice the fact, that vigorous corn crop growing upon fertilized fields, alongside, upon a similar soi showed no smut at the same period of growth.

2. Influence of Fertilizers on the Quantity an Quality of Fodder Crops.

[See Sketch B, p. 409.]

The land selected for the experiment had been used, fo several years previous, for the production of hay. At th beginning of the season of 1883, it had been ploughed an planted with corn, without the addition of any fertilizer The soil consisted of a good sandy loam, and was, in con sequence of its previous treatment, in a suitably impov erished condition to respond to the application of fertilizers

The entire field, consisting of one and one-tenth of a acre, was sub-divided into plats, each one-tenth of an acr in size. Every alternate plat was fertilized at the rate o six hundred pounds of ground, rendered bones, and tw hundred pounds of muriate of potash, per acre. The fer tilizer was applied a few days before seeding, and slightl harrowed under.

The fertilized plats (Nos. 11, 13, 15, 17, 19 and 21 were seeded May 13; and the unfertilized plats (Nos. 12 14, 16, 18 and 20) May 17, 1884.

The experiment comprised four standard grasses, *i. e.* Orchard grass *(Dactylis glomerata)*, Meadow fescue (*Fres tuca pratensis*), Timothy *(Phleum pratensis)*, and Redto *(Agrostis vulgaris)*, besides two millets, — Hungarian

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Germanicum) and Pearl millet, — and
corn (Clark). In the case of the grasses
h plat was again sub-divided in two, and
eded down with one distinct kind of grass
—

), . . .	Orchard Grass (north side). Meadow Fescue (south side).
zed), . .	Orchard Grass (north side). Meadow Fescue (south side).
d), . .	Hungarian Grass (north side). Pearl Millet (south side).
ized), . .	Hungarian Grass (north side). Pearl Millet (south side).
l), . . .	Timothy (north side). Redtop (south side).
ized), . .	Timothy (north side). Redtop (south side).
ed),. . .	Corn (Clark).
ilized), . .	Corn (Clark).
d), . . .	Corn (Clark).
zed), . .	Corn (Clark).

planted the 24th of May, in drills two and
art, at the rate of two bushels per acre.
n the night of from 29th to 30th of May,
llets seriously, and the remaining crops

kept clean by the use of a cultivator. The
eatedly cut, for the mere purpose of killing
Their examination, regarding quality, as well
for obvious reason, deferred to the second
wth.

Results of Experiments with Corn.

ts, ach.	Plat VII.	4,340 lbs.	Total yield, 7,436 lbs.
	Plat IX.	3,096 lbs.	
ats, ach.	Plat VIII.	2,460 lbs.	Total yield, 5,016 lbs.
	Plat X.	2,556 lbs.	

Plats, per acre, ...	37,180 lbs.
d Plats, per acre, ...	25,080 lbs.
l, ...	12,100 lbs.

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The entire crop of corn fodder was cut September
The corn fodders growing upon the fertilized and unfertiliz
plats, differed widely from each other, in their general a
pearance during the second half of the season. The grow
upon the former retained its healthy and vigorous appea
ance to the time of cutting, whilst that raised upon the u
fertilized plats turned gradually yellow, and suffered, at t
close of the season, seriously, from smut.

The crop gathered from the fertilized plats was convert
into ensilage; and that from the unfertilized plats w
stacked in the field for dry corn fodder.

Analysis of Green Fodder Corn.

		Plat VII. (Fertilized.)	Plat VIII. (Unfertilized
	1884.		
July 25, at the beginning of Blooming.	Moisture at 100° C.,	87.62	85.1
	Dry Vegetable Matter,	12.38	14.8
Sept. 1, Kernels in Milk.	Moisture at 100° C.,	72.27	78.7
	Dry Vegetable Matter,	27.73	21.2

Judging from these results it appears that the plants up
the unfertilized plats advanced more rapidly towards matu
ity than those upon the fertilized fields, yet fell considerab
behind in the production of vegetable matter at the close
the season; for one hundred parts of the former contain
only 21.23 per cent. dry matter, while the latter showed
yield of 27.73 per cent. of dry matter, a difference of 6.5 p
cent. One hundred pounds of the fodder corn, grown up
the unfertilized plats, contained at the time of harvesting (ke
nels in milk), 6.5 pounds less of vegetable matter than t
one raised upon the fertilized plats, a difference equal to fro
twenty to twenty-five per cent. of vegetable matter
favor of the fertilized fodder corn. Adding to this adva
tage the difference in the total weight of corn fodder at t
time of harvesting, an amount equal to thirty-three per cen
of the entire growth, it is but proper to state that the tot
effect of the fertilizer on the crop should be rated in our ca
with an increase equal to from forty-eight to fifty per cent.
the entire crop.

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f Dry Vegetable Matter in Corn Fodder (fertilized).

d parts contained: —

. . . . .	3.16 parts.
. . . . .	24.32 "
. . . . .	2.89 "
. . . . .	9.64 "
extract matter, ...	59.99 "

Experiments with Potatoes.

Var.: Beauty of Hebron.

riments were instituted for the purpose of ffects of muriate of potash and of sulphate of yield of potatoes as far as quantity and quality

The conclusions drawn in this direction from tigations are somewhat contradictory. Some vers state that the sulphate of potash produces uber, and thus a more valuable article for family nuriate of potash, while others deny that claim. otato contains usually a liberal percentage of w one of nitrogenous matter. As the degree a plant or part of a plant controls, to a large ative proportions of its proximate organic con- tarch, nitrogenous matter, etc., it seems not st to ascertain whether the noted difference of ing the specific action of sulphate and muriate ht not find a more correct explanation in the t a more or less advanced state of maturity of ops of potatoes tested on previous occasions or the contradictory conclusions on record.

each one-fifth of an acre in size, were chosen ment. The land had been years in grass and e a number of old apple trees. The majority ere removed, and the turf thoroughly broken uring.

vest end) received one hundred and twenty ound rendered bones and thirty pounds of ash (equal to from twenty-six to twenty-seven sphoric acid, four to four and one-half pounds of ifteen to sixteen pounds of potassium oxide).

eived no manure of any kind.

east end) received one hundred and twenty nd rendered bones, fifty-eight pounds of double

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sulphate of potash and magnesia (equal to from twenty-six to twenty-seven pounds of phosphoric acid, four to four and one-half pounds of nitrogen, fifteen to sixteen pounds of potassium oxide, and five to six pounds of magnesium oxide).

The fertilizers were applied broadcast and harrowed under before planting. The potatoes were planted in rows, three feet apart and fourteen inches distant in the drills, during the first week in May, 1884. The crop was kept clean from weeds by a timely use of a cultivator.

As a mere incidental feature of the experiment, one-half of each plat was planted with medium-sized whole potatoes, the other one with half potatoes.

The vines produced by whole potatoes showed a more vigorous growth, during the main part of the season, than those by part of a potato. The entire field looked promising until towards the middle of August, when the appearance of the blight prematurely terminated the life of the stems and leaves.

The crop was harvested on the 9th and 10th of September, with the following results: —

PLAT I.

SEED POTATOES.	Fertilizer applied.	Yield of Potatoes upon One-Fifth of an Acre of Land, in Pounds.		
		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. ground rendered bones and 30 lbs. muriate of potash.	1,085	460	1,545
One-half a Potato,		1,140	335	1,485

PLAT II.

		Large.	*Small.*	*Total.*
Whole Potato, .	Not Fertilized.	830	280	1,110
One-half a Potato,		850	250	1,100

PLAT III.

		Large.	*Small.*	*Total.*
Whole Potato, .	120 lbs. ground rendered bones and 58 lbs. of double sulphate of potash and magnesia.	1,120	342	1,462
One-half a Potato,		930	105	1,035

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Analyses of Potatoes.

veight parts of air-dried fresh potatoes contained:

	From Plat I.	From Plat II.	From Plat III.
atter, ...	19.39	23.30	21.52
. . . . .	80.61	76.70	78.48
	100.00	100.00	100.00

ıred potato contains on an average, approxi-
y-five per cent. of solid matter. The un-
oes were evidently more advanced in growth,
anured with muriate of potash were least ad-
direction.

on the other hand, had the smoothest skins,
ost entirely free from scab, which disfigured
from Plats II. and III.

al, under unfavorable circumstances, does not
ical discussion of results beyond a mere state-
cts as above recorded, it is proposed to repeat
during the coming season.

NTS CONCERNING THE ADAPTATION OF SOME
ED FORAGE CROPS, FROM OTHER LOCALITIES,
CLIMATE AND SOIL.

lity of introducing into our farm management
ety of fodder plants, is generally conceded.
ants for that purpose, it seemed advisable to
which would advantageously supplement our
crop (aside from the products of pasture and
fodder corn and corn stover, as green fodder
the form of hay. Taking this view of the
reat and valuable family of *Leguminosæ* sug-
s a class of plants in a particular degree quali-
rpose, not only, but, in the interest of a wider
introduction of economical systems of rotation
conditions of soil and different requirements

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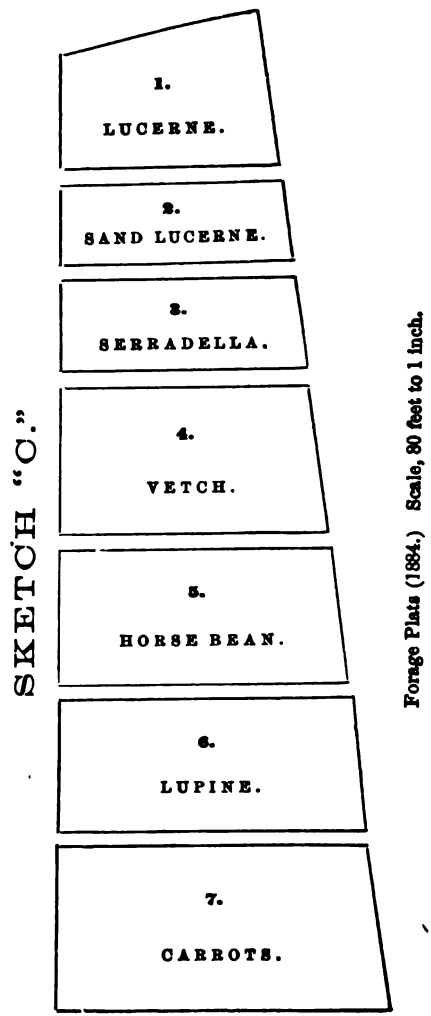
The results thus far obtained upon the fields of the station, although still limited, are not without considerable encouragement. A short description of the work carried on in that direction is given in a few subsequent pages. The experiment with cow peas was carried on during the season of 1883; those with vetch and serradella extended over two seasons, 1883 and 1884; and those with lucerne and horse bean began with the season of 1884.



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ar's observations are mainly directed towards
r with regard to our climate and soil. The
estions involved in their cultivation will receive,
rable, during coming years, special attention.
e crops treated under the above heading suf-
erious extent from the severe frost on the 29th

of the experiments with lupine and two
ucerne are not stated in this report, as the
f the products obtained is not yet finished.
in the field were quite encouraging.

[A.] COW PEA.

OLICHOS (SINENSIS?); VARIETY, CLAY.

xperimental Plats of Station; collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . .	9.30	186.00	–	–	
. . .	90.70	–	–	–	
	100.00		–	–	
ry Matter.					
. . .	9.53	190.60	–	–	
. . .	23.58	471.60	221.65	47	1 : 4.75
. . .	3.81	76.20	44.96	59	
. . .	17.02	340.40	204.24	60	
Extract . .	46.06	921.20	635.63	69	
	100.00	2,000.00	1,106.48	–	

or these experiments were obtained through the
Dr. Dabney, director of the State Experiment
rth Carolina. The rates of digestibility of the
tuents of the hay of the cow pea, above stated,
clover hay, a fodder substance of a similar
he "Clay" variety of the cow pea is considered
e many varieties raised in the Southern States.
this plant are described by a farmer of North
e following words: —

drils but twines like beans, or runs upon its own foliage
growth, making, in three months, on ordinary land, an

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almost impenetrable mass of foliage, two feet high, and so very dense that it destroys all other vegetation, even the thistle, ragweed, and other noxious plants. When well cured these vines are simply invaluable for hay, and worth, as ascertained by actual experiments, 33 to 50 per cent. more than timothy. The only difficulty in making them the leading crop for hay is that it takes three days to cure them. Cattle and horses prefer such hay to the best of herds-grass, and even to corn. Pea vines are the best fertilizer we can use, decomposing very rapidly. I have frequently cut off the vines before they began to run (July 1), and by August the roots would throw out new vines two feet long. The seed sold in May for 75 cents per bushel."

The experimental plats were seeded down towards the latter part of May, and produced a handsome, dense foliaceous growth, about eighteen inches high, at the beginning of August when the samples for analysis were collected.

The early frost in September injured the crop. The plant apparently deserves the importance claimed for it in the above stated report. Its cultivation has proved a success in New Jersey. The only objection which might be raised against its introduction consists in the circumstance that matured seeds cannot be relied on in our section of the country.

As a green fodder it compares well with clover, and most likely would produce a valuable ensilage.

COW PEA.

VARIETY: WHIPPOORWILL.

[From Experimental Plats of Station; collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (In lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.65	193.00	–	–	1:4.74
Dry Matter, ...	90.35	1,807.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	10.46	209.20	–	–	
" Cellulose, ...	22.36	447.20	210.18	47	
" Fat, ...	3.87	77.40	45.67	59	
" Protein (Nitrogenous Matter, ...	16.95	339.00	203.40	60	
Non-nitrogenous Extract Matter, ...	46.36	927.20	639.77	69	
	100.00	2,000.00	1,099.02	–	

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of the preceding table is described as making
e, and is considered less valuable than the
ty. It made a dense foliaceous growth, fully
tter in size. Neither of them produced seeds.

COW PEA.

VARIETY: WHIPPOORWILL.

of Station, as Mixed Crop, with Oats. Collected Aug. 1, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . .	9.75	195.00	–	–	
. . .	90.25	1,805.00	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . .	7.87	157.40	–	–	
. . .	19.06	381.20	179.16	47	1 : 4.95
. . .	4.49	89.80	52.98	59	
Nitrogenous	17.17	343.40	206.04	60	
Extract . . .	51.41	1,028.20	709.46	69	
	100.00	2,000.00	1,147.64	–	

s was made from the pea vines raised with the
ysis of the latter has been reported in Bulletin
This course of separate analysis was adopted
the uneven distribution of both plants. The
as, on the first of August, in excellent condi-
n fodder or hay. An experiment with rye
ount of a bad quality of rye. Assuming the
f peas and oats to consist of three times as
peas, the nutritive ratio of the mixture would
case of two parts of oats and one of cow
would 1 : 10, and in case of even quantities
s, the ratio would be 1 : 8.7. Raised in con-
ye the nutritive value of the mixed crop would
er. Within three months' time, a fodder can
ly equal, if not decidedly superior in nutri-
our best English grasses.

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[B.] Vetch.

(*Vicia sativa; variety, Augustifolia.*)

The vetch has received already considerable attention in various sections of our country; reports thus far speak with much satisfaction of the results. The plant resembles, in many respects, the common garden pea; there are early and late varieties in cultivation. Its period of vegetation is from 18 to 22 weeks, and the time for seeding corresponds with that of the pea. The common vetch is a hardier plant than the latter, and grows well upon an inferior soil. Its reputation as a valuable green fodder, either single or when grown in common with rye, oats or barley, is well established.

The lands were seeded down broadcast, in our experiment during the past season, on the 15th of May. The first crop was secured July 2, at the beginning of blooming. One hundred parts of the plant in that state of growth contained: —

Moisture at 100° C., ...	78.20 per cent.
Dry Matter (vegetable), ...	21.80 " "
	100.00

VETCH.

(Vicia sativa; variety, Augustifolia.)

[I. Collected from Experimental Plats, Aug. 15, 1883, in bloom.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . . .	8.35	167.00	–	–	1 : 4.02
Dry Matter, ...	91.65	1,833.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash, ...	7.97	159.40	–	–	
" Cellulose, ...	30.68	613.60	331.34	54	
" Fat, ...	2.30	46.00	27.60	60	
" Protein (Nitrogenous Matter), ...	15.76	315.20	239.55	76	
Non-nitrogenous Extract Matter, ...	43.29	865.80	562.77	65	
	100.00	2,000.00	1,161 26	–	

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VETCH.

from Experimental Plats, Sept. 3, 1883, when fully matured.]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
° C., . . .	9.45	189.00	–	–	1 : 4.09
. . . .	90.55	1,811.00	–	–	
	100.00	2,000.00	–	–	
Dry Matter.					
. . . .	8.50	170.00	–	–	
, ...	30.05	601.00	270.45	45	
. . . .	2.69	53.80	32.28	60	
(Nitrogenous), ...	14.42	288.40	204.76	71	
s Extract	44.34	886.80	487.74	55	
	100.00	2,000.00	995.23	–	

[C.] SERRADELLA.

(*Ornithopus sativus. Brot.*)

lella, like the vetch, is an annual leguminous found its way from Portugal into central fifty years ago. It grows from one foot to one-half high, and prefers a moist, deep, sandy of seeding and mode of cultivation correspond customary in the cultivation of peas. The plant is slow until the time of blooming, when reases in size and nutritive constituents. The blooming period, at the end of August, is the r cutting the crop. Leading agriculturists ighly of this fodder plant. The field seeded ast on the 15th of May, 1884, produced a first ng on the 22d of July. The plants, at that ir growth, contained in one hundred parts: —

° C., ...	78.66 parts
er (dried), ...	21.34 "
	100.00

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SERRADELLA.

(ORNITHOPUS SATIVUS. BROT.)

[I. Obtained from Plats of the Station, when blooming, Aug. 14, 1883.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.20	144.00	–	–	1:4.72
Dry Matter,	92.80	1,856.00	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.87	117.40	–	–	
" Cellulose,	24.37	487.40	–	–	
" Fat,	2.37	47.40	28.44	60	
" Protein (Nitrogenous Matter),	17.85	357.00	224.91	63	
Non-nitrogenous Extract Matter,	49.54	990.80	990.80	100	
	100.00	2,000.00	1,244.15	–	

SERRADELLA.

[II. From Plats of Station, collected Sept. 3, 1883, when fully matured.]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.70	174.00	–	–	1:5.47
Dry Matter,	91 30	1,826.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.46	129.20	–	–	
" Cellulose,	25.14	502.80	236.32	47	
" Fat,	2.91	58.20	29.10	50	
" Protein (Nitrogenous Matter),	15.26	305.20	183.12	60	
Non-nitrogenous Extract Matter,	50.23	1,004.60	693.17	69	
	100.00	2,000.00	1,141.71	–	

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going stated analyses of Serradella in different
vth (1883), confirm the general observation
ninous plants, like the clover, vetch, beans,
rule, furnish the most nutritious food at the
ng.

[D.] Horse Bean.

(*Vicia Faba. L.*)

me from Southern Russia, and was cultivated
e, already, in Southern Europe. There are
s, small and large, in use. The latter is at
requently raised in the gardens of England,
ermany, for family use; whilst the smaller
the one on trial, is cultivated throughout
der.

beans are considered a valuable food for
cows and swine. The softer parts of the
luable addition to the daily diet of the ma-
farm stock. Beans and straw are highly
The horse bean is considered one of the most
nous plants upon a heavy loam or dry clayish
rate and moderately moist climate. Raised
peas, it serves a twofold purpose, *i. e.*, to
s of these plants, and to increase their feed-
een fodder. They are planted quite early, in
to two and one-half feet distant, and two
the drills. The plant reaches a height of
ree feet at the beginning of blooming, and
low, somewhat angular, juicy stem, with suc-
which at the time of maturing turn black.

on the grounds of the station was seeded
of May, 1884, in rows two and one-half feet
kept clear from weeds by means of a culti-
op was very satisfactory. It began bloom-
week of July. The plants at that time con-
undred parts: —

., ...	87.72 parts.
(dried), ...	12.28 "
	100.00

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At the time of harvesting, when the pods were fully de veloped, one hundred parts of the entire plant contained: –

Moisture at 100° C.,	73.14 part
Vegetable Matter,	26.86 "
	100.00

The crop was cut several inches above ground, put int small shocks, and kept upon the field until September 15 when it was dry enough for storing in the barn. The tot crop at that time weighed 405 lbs.; it lost 4.5 per cent. mor moisture from that date to the 17th of October, when, b thrashing, the beans were separated from the straw.

HORSE BEAN.

(Vicea Faba.)

[Collected from the plats of the Station when harvested.]

Moisture at 100° C.,	73.14 part
Dry Vegetable Matter,	26.86 "

	Straw.	Bea
Moisture at 100 C.,	9.15	10.2
Dry Matter,	90.85	89.7

Analysis of Dry Matter.

Crude Ash,	9.59 per cent.	4.27 per cen
" Cellulose,	41.44 "	8.11 "
" Fat,	1.51 "	1.11 "
" Protein (Nitrogenous Matter),	9.69 "	30.03 "
Non-nitrogenous Extract Matter,	37.77 "	56.48 "
Ratio of Beans to Straw,		46 : 5

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REGARDING THE RATES OF DIGESTIBILITY
BEANS AND STRAW WITH EMPTY PODS.

I. HORSE BEAN.

TS OBTAINED BY FEEDING IT TO CATTLE.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
., . . .	10.28	205.60	–	–	1 : 224.
. . .	89 72	1,794.40	–	–	
	100.00	2,000.00	–	–	
y Matter.					
. . .	4 27	85.40	–	–	
. . .	8 11	162.20	102.19	63	
. . .	1.11	22.20	21.53	97	
Nitrogenous . . .	30.03	600.60	540.54	90	
Extract . . .	56.48	1,129.60	1,061.82	94	
	100.00	2,000.00	1,726.08	–	

II. BEAN STRAW AND PODS.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
y Matter.					
. . .	9.59	191.80	–	–	1 : 8.55
. . .	41.44	828.80	298.37	36	
. . .	1.51	30.20	16.61	55	
Nitrogenous . . .	9.69	193.80	98.84	51	
Extract . . .	37.77	755.40	460.79	61	
	100.00	2,000.00	874.61	–	

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EXPERIMENTS WITH CORN ENSILAGE.

The silo described by Prof. M. Miles in the first annua report of the station has been sub-divided into two independ ent compartments of equal size, each one accessible by separate entrance. This change has been made to mee present resources of corn fodder for ensilage, and to carr on two independent trials if desirable.

One of these silos was filled with cut corn fodder as i the previous experiments. The filling of this silo was carrie on as recommended by Prof. Miles and others, *i. e.*, to fil gradually and to defer the final covering and packing dow to the time when no further increase of temperature in th mass can be noticed. This course purposes to restrict and if possible, prevent the alcoholic fermentation and subsequen formation of acetic acid in consequence of the destruction o the bacteria of fermentation by heat.

The second silo was filled with whole corn fodder, care fully spread out and at once well tramped down. Afte filling, the cover was put on and weighted down withou delay.

The corn was in both cases kept down by an equal weight similar to that in the trial of the previous year, — barrel filled with sand, giving a pressure of about sixty pound to the square foot.

The corn fodder used for the filling of both silos was take from the fertilized plats, which are described in this repor in connection with the experiments concerning the effect o fertilizer on the quantity and quality of crops. The growt of each plat was divided into two parts; one-half was cu into pieces 1¼ to 1½ inches in length, and subsequently fille into one silo, the other half was packed into the secon one without being cut, as above described.

This arrangement secured, as far as practicable, for bot trials, a material of a corresponding general character an

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The entire stock of good fodder corn at our
ted to 15,272 pounds, or seven and six-tenths
n was cut when the kernels were in the milk,
e nutritious ensilage than at an earlier period
l be expected.

nsiderable difference in the value of a fodder
ng out tassels and one with kernels in the
ne used in our case.

n in the former stage of growth contains in
only from twelve to fifteen weight parts of
matter in one hundred of the entire plant,
more advanced stage of growth, when the
he milk and the whole plant still green, the
matter contained in one hundred weight parts
lant varies usually between from twenty-five
parts; therefore, a difference of thirty-three
ual fodder, pound for pound, in favor of the
growth.

his decided advantage in actual weight, it is
that the quality of the fodder obtained from
red fodder corn is of a superior nutritious
compared with that of the less matured
e nitrogenous constituents of the more ma-
rn, although less in quantity, are more largely
albuminoids) better fitted for the formation
hey are at an earlier stage of growth. The
also richer in valuable non-nitrogenous con-
, sugar and starch, than in the latter case.

the degree of temperature within the ensilage
ages of its alteration, a gas-pipe one and one-
iameter was driven, in each case, through a
e in the cover of the silo to within one foot
A thermometer was kept inside of this tube
ne to time the changes in the temperature of
The results of these observations are stated

for filling the silo amounted to $1.50 per ton
ensilage.

re not yet opened a further discussion of the
to be deferred to an early bulletin of the

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Observations on Whole Fodder Corn in Silo.

Commenced filling the silo at 7 o'clock, A.M., Septeml 1, and finished at 2 o'clock, P.M., the same day. The ma with weights on, measured at once 5 ft. 4¼ in. in dept first temperature observed in the tube at 3 o'clock, P.I September 1, was 77° F. (25° C.); outside temperatu 71.6° to 73.4° F. (22° to 23° C.).

DATE.	Time of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkag
Sept. 1,	5 o'clock, P.M.	77.° F.	–	5 ft. 2⅜ in.	1½ incl
2,	8.30 o'clock, A.M.	78.8°	–	5 " 1¼ "	2⅞
3,	" " "	81.5°	–	4 " 10⅜ "	3
4,	" " "	85.1°	–	4 " 7⅜ "	3⅛
5,	" " "	89.6°	–	4 " 4¼ "	2⅝
6,	" " "	89.6°	–	4 " 1⅝ "	2¼
7,	" " "	88.7°	–	3 " 11⅛ "	1⅝
8,	" " "	93.2°	–	3 " 9½ "	1⅝
9,	" " "	93.2°	–	3 " 7⅞ "	1
10,	" " "	94.1°	–	3 " 6⅞ "	1⅜
11,	" " "	94.1°	86.° F.	3 " 5⅜ "	⅜
12,	" " "	86.°	68.°	3 " 4⅞ "	⅝
13,	" " "	82.4°	57.2°	3 " 4⅜ "	⅝
14,	6 o'clock, P.M.	84.2°	64.4°	3 " 3⅝ "	⅜
15,	8.30 o'clock, A.M.	82.4°	53.6°	3 " 3⅜ "	⅜
16,	8.30 o'clock, P.M.	82.4°	64.4°	3 " 3⅛ "	⅜
17,	" " "	82.4°	68.°	3 " 2⅜ "	⅝
18,	" " "	82.4°	62.6	3 " 2⅜ "	⅛
19,	" " "	80.6°	55.4°	3 " 2⅜ "	⅜
20,	" " "	80.6°	55.4°	3 " 2 "	⅛

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ns on Whole Fodder Corn, etc. — Concluded.

e of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkage.
clock, P.M.	79.7°	55.4°	3 " 1 7/8 in.	1/8 inches.
" "	78.8°	57.2°	3 " 1 5/8 "	0 "
" "	77.°	60.8°	3 " 1 5/8 "	0 "
" "	75.2°	55.4°	3 " 1 5/8 "	3/8 "
" "	77.°	75.2°	3 " 1 3/8 "	0 "
" "	74.3°	57.2°	3 " 1 3/8 "	3/8 "
" "	75.2°	57.2°	3 " 1 1/8 "	0 "
" "	74.3°	71 6°	3 " 1 1/8 "	0 "
" "	75.2°	71.6°	3 " 1 1/8 "	0 "
" "	75.2°	62.6°	3 " 1 1/8 "	0 "
" "	73.4°	–	3 " 7/8 "	3/8 "
" "	73.4°	–	3 " 7/8 "	0 "
" "	71.6°	–	3 " 5/8 "	1/8 "
" "	71.6°	–	3 " 5/8 "	0 "
" "	71.6°	–	3 " 5/8 "	0 "
" "	69.8°	–	3 " 3/8 "	0 "
" "	69.8°	–	3 " 3/8 "	0 "
" "	68.°	–	3 " 3/8 "	0 "
" "	–	–	– –	– –
" "	–	–	– –	– –
" "	–	–	– –	– –
" "	68.°	59.°	3 " 1/8 "	3/8 "
" "	62.6°	46.4°	3 " 1/8 "	0 "
" "	62.6°	–	3 " 1/8 "	0 "
" "	59.°	–	3 " 1/8 "	0 "

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Observations with Cut Fodder Corn in Silo.

Commenced filling the silo at 3 o'clock, P. M., Septembe 1st, and finished at 12 o'clock, M., September 2d. Whol thickness of ensilage after levelling, taken at once, was ft. 10⅞ in.; temperature in the mass at 1 o'clock, P. M. September 2d, was 71.6° F. (22° C.). The weights wer put on September 6th, when the temperature of the mas (122° F.) had ceased to increase.

DATE.	Time of Day.	Temperature in Tube.	Outside Temperature.	Thickness of Ensilage.	Shrinkage.
Sept. 1,	–	–	–	– –	– –
2,	–	–	–	4 ft. 10⅞ in.,	– –
3,	6 o'clock, P.M.,	77.° F.,	–	– –	– –
4,	8.30 o'clock, A.M.,	78.8°	–	– –	– –
5,	" " "	82.4°	–	4 ft. 7⅛ in.,	3⅝ inche
6,	" " "	84.2°	–	4 " 6⅝ "	⅜ "
7,	" " "	86.9°	–	3 " 11⅝ "	7⅝ "
8,	" " "	86.9°	–	3 " 10⅝ "	⅝ "
9,	" " "	86.9°	–	3 " 10 "	⅝ "
10,	" " "	87.8°	–	3 " 9⅝ "	⅝ "
11,	" " "	88.7°	86.° F.,	3 " 9⅝ "	⅛ "
12,	" " "	87.8°	68.°	3 " 8⅞ "	⅝ "
13,	" " "	83.3°	57.2°	3 " 8⅝ "	⅝ "
14,	6 o'clock, P.M.,	84.2°	64.4°	3 " 8⅝ "	0 "
15,	8.30 o'clock, A.M.,	84.2°	53.6°	3 " 8⅝ "	0 "
16,	8.30 o'clock, P.M.,	82.4°	64.4°	3 " 8⅛ "	⅜ "
17,	" " "	82.4°	68.°	3 " 8⅛ "	0 "
18,	" " "	82.4°	62.6°	3 " 7⅞ "	⅜ "
19,	" " "	80.6°	55.4°	3 " 7⅞ "	0 "
20,	" " "	80.6°	55.4°	3 " 7⅞ "	0 "

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ns with Cut Fodder Corn, etc. — Concluded.

e of Day.	Temperature in Tube.	Temperature Outside.	Thickness of Ensilage.	Shrinkage.
clock, P.M.	78.8°	55.4°	3 " 7 7/8 in.	0 inches.
" "	78.8°	57.2°	3 " 7 7/8 "	0 "
" "	77.°	60.8°	3 " 7 7/8 "	0 "
" "	77.9°	55.4°	3 " 7 7/8 "	0 "
" "	77.°	72.5°	3 " 7 7/8 "	0 "
" "	76.1°	57.2°	3 " 7 5/8 "	1/8 "
" "	75.2°	57.2°	3 " 7 5/8 "	0 "
" "	75.2°	71.6°	3 " 7 5/8 "	0 "
" "	75.2°	71.6°	3 " 7 5/8 "	0 "
" "	73.4°	62.6°	3 " 7 5/8 "	0 "
" "	75.2°	–	3 " 7 5/8 "	0 "
" "	73.4°	–	3 " 7 5/8 "	1/8 "
" "	73.4°	–	3 " 7 5/8 "	0 "
" "	73.4°	–	3 " 7 5/8 "	0 "
" "	73.4°	–	3 " 7 5/8 "	0 "
" "	73.4°	–	3 " 7 5/8 "	0 "
" "	71.6°	–	3 " 7 5/8 "	0 "
" "	–	–	– –	– –
" "	69.8°	–	3 " 7 3/8 "	3/8 "
" "	68.°	–	3 " 7 3/8 "	0 "
" "	64.4°	–	3 " 7 3/8 "	0 "
" "	62.6°	–	3 " 7 3/8 "	0 "
" "	60.8°	–	3 " 7 3/8 "	0 "

temperature observed in the mass was noticed
September 4th, and registered, at about 18
rface, 116.6° F. (47° C.).

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Analyses of Fodder and Fodder Crops.

Analyses of Hampden Prolific Corn.

[Samples sent on for examination.]

I. Raised by J. Lyman Shepard of Westfield, Mass., upo a sandy loam soil. The ear was nine and three-fourth inche long, of a whitish color, and contained eighteen rows o kernels. The weight of the ear was 473.4 grams, and tha of the cob 111.30 grams. The cob was of a red color, an comprised 23.5 per cent. of the weight of the ear, the othe 86.5 per cent. being kernels. The average weight of on kernel was .433 gram.

	Moisture.	Fat.	Nitrogenous Matter. (Protein.)	Non - nitrogenous Extract Matter.	Cellulose.	Ash.
Kernels, . . .	10.00	4.068	10.224	72.207	1.953	1.548

Nutritive ratio of kernels, 1 : 8.248.

II. Raised by Mrs. M. A. Clyde of Brightwood, Mass. upon a heavy soil. The ear was ten inches long, of a whitish color, and contained twenty rows of kernels. The weight of the ear was 491.4 grams, and that of the cob 107.4 grams. The cob was of a red color, and comprised 21.86 per cent. of the weight of the ear, the other 88.14 per cent. being kernels. The average weight of one kernel was 3.996 grams.

	Moisture.	Fat	Nitrogenous Matter. (Protein.)	Non - nitrogenous Extract Matter.	Cellulose.	Ash.
Kernels, ...	10.00	4.761	12.357	69.579	1.782	1.521

Nutritive ratio of kernels, 1 : 6.73.

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CORN STOVER.

[From Plats of the Station, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	8.73	174.6	–	–	1:21.16
. . . .	91.27	1,825.4	–	–	
	100.00	2,000.0	–	–	
Dry Matter.					
. . . .	3.12	62.4	–	–	
. . . .	34.28	685.6	–	–	
. . . .	1.27	25.4	7.62	30	
(Nitrogenous					
, ...	6.58	131.6	52.64	40	
; Extract					
. . . .	54.75	1,095.0	1,095.00	100	
	100.00	2,000.0	1,155.26	–	

WHEAT GRAIN.

[From Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	10.58	211.60	–	–	1:6.42
. . . .	89.42	1,788.40	–	–	
	100.00	2,000 00	–	–	
Dry Matter.					
. . .	2.18	43.60	–	–	
. . . .	2.42	48.40	–	–	
. . . .	1.79	35.80	30.64	80.0	
(Nitrogenous					
, ...	13.35	267.00	240.30	90.0	
; Extract					
. . . .	80.26	1,605.20	1,484.81	92.5	
	100.00	2,000.00	1,755.75	–	

sition of this article is a very fair one.

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WHEAT STRAW.

[From the Plats of the Station.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.50	130.00	–	–	1:29.09
Dry Matter,	93.50	1,870.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.44	148.80	–	–	
" Cellulose,	40.74	814.80	423.70	52	
" Fat,	1.59	31.80	8.59	27	
" Protein, (Nitrogenous Matter),	5.32	106 40	27.66	26	
Non-nitrogenous Extract Matter,	44.91	898.20	359.28	40	
	100.00	2,000.00	819.23	–	

The composition of this sample is better than the average article.

PEARL MILLET (IN BLOOM).

[Collected from Plats of Station, Sept. 19, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.20	124 00	–	–	1:8
Dry Matter,	93.80	1,876.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.80	96.00	–	–	
" Cellulose,	35.91	718.00	–	–	
" Fat,	1.63	32 60	13.69	42	
" Protein, (Nitrogenous Matter),	7.20	144.20	86.40	60	
Non-nitrogenous Extract Matter,	50.46	1,009.20	655.98	65	
	100.00	2,000.00	756.07	–	

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COMMON MILLET.

[from Plats of Station, when blooming, Aug. 14, 1883.]

I.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	6.15	123.00	–	–	1:8.32
. . .	93 85	1,877.00	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . .	4.67	93.40	–	–	
. . .	29.80	596.00	–	–	
. . .	2.04	40.80	17.14	42	
Nitrogenous . . .	7.69	153.80	92.28	60	
Extract . . .	55.80	1,116.00	725.40	65	
	100.00	2,000.00	834.82	–	

COMMON MILLET.

[Plats of the Station, when fully matured, Sept. 3, 1883.]

II.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	6.73	134.60	–	–	1:8.5
. . .	93.27	1,865.40	–	–	
	100.00	2,000.00	–	–	
Dry Matter.					
. . .	4.23	84.60	–	–	
. . .	33.39	667.80	–	–	
. . .	2.67	53.40	21.36	40	
(Nitrogenous), . . .	7.09	141.80	85.08	60	
s Extract . . .	52.52	1,052.40	631.44	60	
	100.00	2,000.00	737.88	–	

es of both samples point towards an exhausted the soil on which they were raised.

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HUNGARIAN GRASS (PANICUM GERMANICUM).

[From the Farm of Levi Adams, Hadley, Mass., collected in bloom, Sept. 4, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.45	149.00	–	–	1 : 6.22
Dry Matter,	92.55	1,851.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.73	114 60	–	–	
" Cellulose,	31 96	639.20	–	–	
" Fat,	2.22	44.40	18.65	42	
" Protein (Nitrogenous Matter),	9.45	189.00	113.40	60	
Non-nitrogenous Extract Matter,	50.64	1,012.80	658.32	65	
	100.00	2,000.00	790.37	–	

The composition of the above sample is very fair.

BARNYARD GRASS (PANICUM CRUS-GALLI.)

[Collected in bloom from College Farm, Aug. 14, 1883.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.65	133.00	–	–	1 : 2.94
Dry Matter,	93.35	1,867.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	10.82	216.40	–	–	
" Cellulose,	33.72	674.40	–	–	
" Fat,	1.95	39.00	16.34	42	
" Protein (Nitrogenous Matter),	15.27	305.40	183.24	60	
Non-nitrogenous Extract Matter,	38.24	764.80	497.12	65	
	100.00	2,000.00	696.74	–	

This grass is found quite frequently around barns and compost heaps as a weed. The analysis of the above sample

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ly the influence of a liberal manuring on the
f the species of plants of which it is a variety.

CORN MEAL.

passed through mesh 144 to square inch, Sept., 1884.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . .	11.95	239.00	–	–	1 : 7.42.
. . .	88.05	1,761.00	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . .	1.59	31.80	–	–	
. . .	2.59	51.80	17.61	34	
. . .	4.43	88.60	67.34	76	
Nitrogenous . . .	13.13	262.60	223.21	85	
Extract . . .	78.26	1,565.20	1,471.29	94	
	100.00	2,000.00	1,779.45	–	

CORN MEAL.

passed through mesh 144 to square inch, August and September, 1884.

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . .	12.40	248.00	–	–	1 : 9.25
. . .	87.60	1,752.00	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . .	1.66	33.20	–	–	
. . .	2.71	54.20	18.43	34	
. . .	4.14	82.80	62.93	76	
Nitrogenous . . .	10.77	215.40	183.09	85	
Extract . . .	80.72	1,614.40	1,517 54	94	
	100.00	2,000.00	1,781.99	–	

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SUGAR BEET PULP. (Diffusion Mode.)

[From the Franklin Factory.]

	Per Cent
Moisture at 100° C.,	89.680
Dry Matter at 100° C.,	10.320
Organic Matter,	10 201
Ash,	0.107
Fat,	0.098
Crude Fibre,	2.450
Non-nitrogenous Extract Matter,	6.384
Nitrogenous Matter,	1.281

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000 lbs.	Pounds Digestible in a Ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	89.68	1,793.60	–	–	1: 7.1
Dry Matter,	10.32	206.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.04	20.80	–	–	
" Cellulose,	23.74	474.80	474.80	100	
" Fat,	.95	19.00	19.00	100	
" Protein (Nitrogenous Matter),	12.41	248.20	248.20	100	
Non-nitrogenous Extract Matter,	61.86	1,237 20	1,237.20	100	
	100 00	2,000.00	1,979.20	–	

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NTS WITH SPECIAL FERTILIZERS IN FRUIT CULTURE.

URRANTS AND PEACHES.

ents with currants, which are described in communication, are but a continuation of an augurated upon the college grounds ten years

ments with sugar beets, for the purpose of influence of special fertilizers on the saccha- suggested the extension of the inquiry to ants.

of brevity, and of a desirable understanding volved, I reproduce here the introduction of publications on the subject under discussion: whether a systematic and rational manuring ring plants is essential for the continued pro- l crops, engages more attention from year to merely from the results obtained in general ent, in consequence of the adoption of the annually to the soil under cultivation, either nt or in part, as circumstances may advise, nstituents which the crops carried off have ems but reasonable to assume that the same d to the cultivation of fruit and garden crops t prove in the end most advantageous, as far uantity of the crops resulting are concerned. ply, in particular, of those essential elements hich are found in the fruits in conspicuous for obvious reasons must serve important eir growth, if judiciously provided cannot rove beneficial to the entire plant.

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To secure that amount in a more definite form than a
general rule has been customary, improves most decide
our chances to ascertain, not only the special wants of
plants under cultivation, but to recognize also the particu
form in which the various elements of plant food exert th
most valuable influence on the quality of the crops. Beli
ing in the correctness of these views, I entered a few ye
ago upon a series of analytical chemical inquiries to det
mine the character of the ash constituents of fruits, and
study, also, the relations which apparently exist between
variations in the composition of the former and the qual
of the latter, for the purpose of furnishing information nee
for the *successful* introduction of a *rational system* of *fe*
lization of our *fruit-bearing plants.*"

These investigations have been carried on since with
serious interruption, as far as the limited resources of p
years for experimental work of that character have p
mitted. The scarcity of previous systematic chemical
quiries into the relations existing between the kind and
amount of available plant food in a productive garden
or orchard, and the absolute and relative quantity of
various soil constituents contained in the fruit and gar
crops raised upon it, rendered it necessary to grow th
under well defined circumstances, to obtain material fit
comparative analyses.

The necessity of adopting that course of action beca
still more apparent, when considering the extraordinary
fluence — quite generally conceded — of soil, location a
season on the quality of these crops. Products raised
the aid of different manurial substances, within the *sa*
season, upon a *similar soil*, and of a *corresponding stage*
growth, had to be secured for the examination, to impar
scientific and practical value to the analytical results.

It is a well-known fact that the *absolute amount* of
mineral constituents of plants of the same variety, and
one and the same species, even, may differ widely, yet, a
rule, this circumstance does not necessarily alter the gene
character of the plants.

A change, however, in the *relative proportion* of the va
ous mineral constituents, as potassa, lime, etc., rarely

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ithout having affected the quantity of some of
nstituents, as sugar, starch, acids, etc.
t the essential mineral constituents (potassa,
nesium, iron and phosphorus) of our farm
replace each other beyond a certain extent in
economy without endangering their life, points
ific function of each of them in the growth of
We have learned, by experimental observa-
nents are indispensable for a healthy growth,
ul reproduction of these plants. It remains
ascertain the particular function of each of
ments in the life of plants. The more we
ecific functions of each essential mineral con-
nts, the better will we be prepared to perfect
manuring; to cultivate with a view of devel-
qualities in the crops, and to counteract the
ces of an abnormal composition of the sap,
plants.
suitable material for an examination in the
ed direction, five experimental plats were set
purpose in 1875. They were planted under
of Prof. Maynard, with strawberries, rasp-
nts and blackberries, besides cherry, plum,
e trees. Four of these plats received, annu-
kind and amount of chemical manure (see
ments), while one plat received no manure.
at were planted the same kind and variety of
interesting observations made on grape-vines
ies have been already published in the annual
college, in the report of the Massachusetts
of Agriculture for 1879, and elsewhere. A
on of experiments with healthy peach trees,
suffering with "the yellows," has been pub-
eport of the Massachusetts Horticultural So-
the State Board of Agriculture for 1882.
d description of these experiments, in partic-
found in the annual report of the Board of
State Experiment Station, for 1883. The
ith currants, below described, furnish an in-
ion to previous observations.

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Experiments with Currants.

Red Currants (Versailles).

The plants furnishing the fruits for the examination h been for several years under special treatment upon five d ferent experimental plats. The ground upon which the plats are located has served, for years previous to its pre ent use, for the production of grass. The soil consists of light gravelly loam. Each plat covers an area of 4.20 square feet; four of them have received, annually, for fi to six years past, a definite amount and kind of spec chemical manure, while one plat received none. The fert izer was applied broadcast early in the spring, and subs quently incorporated in the soil by means of a cultivato The plats were otherwise treated alike to secure a good m chanical condition of the soil, and to keep off the weeds.

Fertilizers Applied.

Plat I. received annually forty-five pounds of dissolv boneblack, containing from ten to twelve per cent. of sol ble phosphoric acid, and fifteen pounds of potash nit (saltpetre).

Plat II. received annually fifteen pounds of potash nit and thirty pounds of kieserite.

Plat III. received annually forty-five pounds of dissolv boneblack, fifteen pounds of potash nitre and thirty poun of kieserite.

Plat IV., nothing applied.

Plat V. received annually forty-five pounds of dissolv boneblack, eighteen pounds nitrate of soda (Chili saltpetr and fifteen pounds of muriate of potash.

Nitrogen was applied in form of nitric acid, to secure uniform action of that element.

Well-matured fruits were in every instance secured for t tests. They were collected July 18, 1883, and examin without delay.

One hundred parts by weight of the berries contained, —

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	I.	II.	III.	IV.	V.
er, .	13.76	13.61	15.72	12.95	13.86
. .	86.24	86.39	84.28	87.05	86.14
. .	.45	.45	.48	.41	.45

on of the composition of the berries showed
r, the largest amount of vegetable matter,
amount of mineral constituents in the fruits
The fruits from Plat V. rank next in regard
s, yet exceed in sugar by more than one per

m Plat IV. (without fertilizer) rank lowest
examination of the organic constituents of
be repeated during the coming season, when
l be published.

Analysis of Fruit with Stems.

	I.	II.	III.	IV.	V.
, .	1.84	.99	.95	1.20	.75
. .	54.35	56.12	54.32	47.68	59.34
. .	5.42	2.35	2.56	4.02	4.04
. .	4.10	5.08	5.49	6.23	4.61
. .	15.96	17.21	17.68	18.96	14.69
. .	18.33	18.25	19.00	21.91	16.57
	100.00	100.00	100.00	100.00	100.00

these analyses of the currants are calculated
th reference only to the several constituents
above statement, for the purpose of render-
ns in their quantitative relations more con-
r ash constituents, as sulphur, chlorine and
ne present for various reasons excluded from

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the discussion. A careful consideration of the compositi of the ash obtained from fruits raised upon the *unfertiliz* plat (IV.), as compared with any of those obtained fr fruits raised upon the *fertilized* plats, cannot fail to lead the conclusion, that the unfertilized soil contained an am supply of available phosphoric acid, magnesia, soda a iron; for even an actual addition of these important pla constituents, in the form of fertilizer, to the soil of Plats III. and V., failed to increase the quantity of these consti ents above that found in the ash of fruits raised upon t unfertilized plat. The only ash constituent in which t unfertilized soil seems apparently to have been deficient, available potassa.

An addition of potash compounds to the soil has in eve instance increased the percentage of potassa in the frui varying from six to eleven and more per cent. The fr gathered from Plat V. showed the most remarkable diff ence in that direction. Potash fertilizers have decided improved desirable qualities in the fruits; those from Plat proved the most saccharine.

Aside from the practical lessons which may be glean from the above described experiment, there is another fe ture of the analytical results deserving a serious consider tion; namely, the *increase* of *potassa* in the currants invariably accompanied by a *corresponding decrease* of pho phoric acid, and of *lime* in particular. This result coincid with my previous observations concerning the action potash fertilizers on grapes, strawberries and peaches.

The circumstance that the most striking alteration in t mineral constituents of the currants has been produced muriate of potash, seems to be of particular interest in co nection with some of my previous experiments regarding t effects of that potash compound on *diseased peach trees.*

The examination of fruits and of young branches fro peach trees affected by

"*The Yellows*"

disclosed the fact that they contained a large amount of lim and more phosphoric acid than fruits and young branch collected from healthy peach trees of the same variet

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of diseased peach trees has since been recog-
R. C. Kedzie, — on trees raised in Michigan,
to J. P. Leland, published Jan. 29, 1884, in
Gazette."

und, in our experiments, that a repeated appli-
iate of potash, in connection with a judicious
ored the affected trees to a vigorous growth,
branches and fruit to a normal amount of
and phosphoric acid. The excess of lime dis-
both fruit and branches, and the trees are
Prof. Maynard as restored to a healthy bear-

ations on currants (Plat V.) furnish an addi-
ion of the beneficial effects claimed by me for
potash.

ance of the interests involved renders a fair
elsewhere. The details of the mode of opera-
shed in the First Annual Report of the Board
the Experiment Station. The director of the
ked to be favored with information regarding
ained.

ying to be able to state that the treatment of
ecommended on previous occasions, has been
extensively in various localities with many
esults.

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MISCELLANEOUS ANALYSES.

Asparagus.

	Stems.	Roots.
Moisture at 100° C.,	5.53	4.85
Dry matter,	94.47	95.15
Nitrogen in dry matter,	1 98	1.48
Insoluble in acids,	.08	3.67

One hundred parts of crude ash contained:—

	Stems.	Roots.
Potassium oxide,	42.94	56.43
Sodium oxide,	3.58	5.42
Calcium oxide,	27.18	15.48
Magnesium oxide,	12.77	7.57
Phosphoric acid,	12.31	15.09
Sesquioxide of iron,	1.22	Not determined

The examination has been carried on at the especial request of several garden farmers in the eastern part of the State. The plants serving for the analysis were raised upon the college grounds, upon a light, loamy soil, which previously had been occupied by grasses.

The comparatively small amount of soda in the ashes of both stems and roots confirms the impression that the beneficial influence of common salt on asparagus beds, not unfrequently reported, is due rather to its action on the physical condition of the soil than to its requirement as plant food. The common salt increases the hydroscopic quality of the soil, assists in the diffusion of potassa and phosphoric acid, and rarely supplies deficiencies in the soil, as far as its own constituents are concerned. A judicious application of muriate of potash, with sulphate of magnesia (Kieserite) tends to secure available potash throughout the entire body of the soil penetrated by the extensive root mass of the plants.

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sis of the Ash of the Clinton Grape.

	A.	B.
on,	.88	.91
	57.40	59.49
	3.51	59.49
,	7.24	7.50
	13.10	13.58
	17.87	18.51
	100.00	100.00

sis of the Baldwin Apple (Matured).

d parts of ash, soluble in hydrochloric acid,

n,	1.08
	63.54
	1.71
,	5.52
	7.28
	20.87
ochloric,	3.68

e Ash of Corn Cobs (Longfellow Variety).

l parts of cobs contained: —

at 100° C.,	12.00
	1.38
	86.62

l parts of the ash contained: —

	65.89
	2.94
	2.61
	3.22
	1.16
	5.44
	18.74

. of potash present is as large as that found cultivated grapes.

Analysis of Beet-sugar Molasses.

[From Roots grown on College grounds.]

	5.27	
	24.60	per cent.
	15.84	" "
	2.24	" "
	9.10	" "

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Phosphoric acid,	trace.
Iron oxide,	1.44 per cen
Silicic acid,	3.66 " "
Carbonic acid, chlorine, and sulphuric acid,	not determined

As the molasses had been treated with boneblack, th phosphoric acid had been abstracted, and the relative pro portion of other mineral constituents of the sugar beet, a tered. The potash obtained from the molasses of the suga beet is considered valuable for the manufacture of the fine qualities of glass. The beet-sugar manufacturer usuall changes, by fermentation, the sugar of the molasses int alcohol; and evaporates the refuse of the still to dryness and chars the refuse. The potash is abstracted from th charred mass in a similar way as from any other ash.

Ozone.

"The most valuable article in the world."

[Prentiss Preserving Co., Cincinnati, Ohio. Sent on for examination by the "Ne England Homestead," Springfield, Mass.]

Moisture at 100° C. (including a trace of aromatic matter),	0.800 per cen
Carbon,	6.080 " "
Ash,	.600 " "
Sulphur,	92.52 " "

The pretensions of the manufacturer regarding the valu of this compound are not less strange than the name unde which it is offered for sale.

The Phœnix Fruit Tree Invigorator.

(Manufactured by the Phœnix Fruit Tree Invigorator Co., of Livonia, Livingstone County, N. Y.)

"A specific for the Aphis on Fruit Trees and Berry Bushes of all kinds."
"Patent Secured."

[Sent on for examination by the editor of the "New England Homestead," Spring field, Mass.]

One hundred parts of the material contained: —

Moisture at 100° C.,	21.75
Sulphur free,	41.25
Sulphur combined (with alkalies),	1.66
Sulphuric acid,	.64
Phosphoric acid,	.82
Chlorine,	.20
Carbonic acid,	9.54

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e,	.68
oxide,	1.13
oxide,	3.34
ide,	14.08
tities of soda with coal, etc.,	2.07
uents insoluble in acids,	2.84
	100.00

Claims of the Manufacturer.

nnd, when applied to plants or trees, is taken up by the ne sap, and carried by it to the leaves, where it is reor-tributed to all parts of the tree, giving the tree a healthy rous growth.

ound box, $1.50."

rections given by the Manufacturer for use.

rees. Bore into the trunk of the tree, near the ground, e heart is nearly reached; and fill the opening with the Tree Invigorator, and close tight with a thin cork, or A wooden stopper may be used. Apply any time dur-nd spring, till the first of June.

Currant, Rose Bushes, and house plants. Remove the ark from the roots, and apply the invigorator, covering "

of applying the offered remedy for the destruc-: life, and for the promotion of a healthful nts, requires certainly a serious operation, and f at all contemplated, ought to be carried out cale. The proposition to introduce the remedy the circulation of the plant, is not without its e treatment of animals. One point, however, rfully conceded — the patentee means to get a iary compensation for his claimed discovery. an essentially corresponding composition may at an expense of from twelve to fifteen cents retail cost, by taking from 40 to 42 pounds of ar, and 58 to 60 pounds of sifted wood ash.

of a Bowel Stone discharged by a Horse.

[Obtained from Dr. Cressey.]

C.,	1.70	per cent.
atile Matter,	43.90	" "
	56.10	" "
	1.455	" "

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Phosphoric acid,	0.885	per cent.
Calcium oxide,	41.170	" "
Carbonic anhydride,	30.60	" "

One hundred parts contained: —

Moisture at 100° C.,	1.700	per cent
Carbonate of lime,	69.546	" "
Tricalcic phosphate,	1.935	" "
Nitrogen containing organic matter,	26.819	" "
	100.000	

Analysis of a Urinary Calculus found in the Bladder of a Hog.

[Obtained from Dr. Cressey.]

One hundred parts contained: —

Moisture at 100° C.,	8.650	per cent.
Tricalcic phosphate,	10.981	" "
Carbonate of lime,	8.688	" "
Phosphate ammoniate of magnesia,	7.710	" "
Nitrogen containing organic matter,	63.971	" "

Diabetic Urine.

[Sent on for examination from Amherst.]

Specific gravity,	1.04	per cent.
Reaction (acid),		
Solids,	8.40	" "
Grape sugar,	6.95	" "
Mineral matter (in solids),	1.31	" "

Containing calcium, phosphoric acid, chlorine, potassium oxide, nitrogen, etc.

Sewage Water.

[Samples sent on by the Secretary of the State Board of Agriculture, John E Russell.]

One hundred thousand parts contained: —

Solids,	1064.00	per cent
Chlorine,	491.20	" "
Sulphuric acid,	71.23	" "
Phosphoric acid,	traces.	
Magnesium oxide,	57.29	" "
Calcium oxide,	20.20	" "
Sodium oxide,	182.98	" "
Potassium oxide,	5.50	" "
Total nitrogen,	8.34	" "
Nitrogen in free ammonia,	3.22	" "
Nitrogen in dry matter,	5.12	" "

This water contains considerable quantity of saline constituents peculiar to the water of the ocean.

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TION OF FERTILIZERS, AND ERTILIZER ANALYSES.

UES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per Pound.			
	1881.	1882.	1883.	1884.
onia salts, ...	22½	29	26	22
tes, ...	26	26	20	18
and fine ground fish, .	20	24	23	20
in guano, and fine ground t, ...	20	24	23	18
in cotton seed, linseed stor pomace, . . .	16	18	18	18
in fine ground bone, .	15	17	17	18
in medium fine bone, .	14	15	15	16
in medium bone, . .	13	14	14	14
in coarse medium bone,	12	13	13	12
n in coarse bone, horn and fish scraps, . .	11	11	11	10
soluble in water, . .	12½	12½	11	10
oluble in ammonia citrate,*	9	9	8	9
insoluble in dry, fine d in fine bone, . . .	6	6	6	6
insoluble in fine medium	5½	5½	5½	5½
nsoluble in medium bone,	5	5	5	5
nsoluble in coarse medium	4½	4½	4½	4½
insoluble in coarse bone,	4	4	4	4
insoluble in fine ground , ...	3½	3	2¾	2¼
ade sulphate, . . .	7½	7	7	7¼
. . . . .	5½	5	4¼	4¼
e, ...	4½	5	4¼	4¼

vo grams of phosphate, unground, by 100 c. c. neutral solution of am-
1.09 in 30 minutes at 40 deg. C., with agitation once in five minutes;
erted" or backgone phosphoric acid.

rade values are the figures at which, on March respective ingredients could be bought at , in our markets in the *raw materials*, which

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are the regular source of supply. They also correspond t
the average wholesale quotations.

The calculated values obtained by the use of the abov
figures will be found to agree with the reasonable reta
price in case of standard raw materials, such as, —

Sulphate of Ammonia,	Azotin,
Nitrate of Soda,	Dry Ground Fish,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bones,

Plain Superphosphates.

The particular rate of valuation of each ingredient use
for manurial purposes depends, in many instances, largel
on its mechanical condition and its peculiar form of con
bination. For instance, in factory-waste, and animal an
vegetable refuse of various descriptions.

It has been the aim in previous reports of the station t
describe briefly, in connection with analytical reports r
garding their composition, the peculiar character and speci
merits of prominent agricultural chemicals, and of refus
materials of various industries which are commonly used fo
the manufacture of compound fertilizers for farm purposes.

This feature of the reports will be retained for the futu
wherever an inducement is offered. The information thu
far given on these occasions may be improved by studyin
the official annual reports on commercial fertilizers pul
lished for ten years past in the report of the Massachuset
State Board of Agriculture. A knowledge of the source
and of the character of the ingredients which serve largel
for the manufacture of our commercial fertilizers, lead
quite naturally to a due appreciation of the importance o
securing the *proper form* for our circumstances. No mod
of supplying our special wants of plant food for a successfu
and economical cultivation of crops is as safe as the practic
to supplement, if needed, our home-made manures wit
commercial fertilizing ingredients, in the form of suitabl
raw materials and chemicals to meet our wants; and
obliged to increase our home resources of manure, to com
pound them from the most suitable stock in the market
Although a first trial of that course of action may not realiz

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tages expected, there can be no doubt about the
f the statement, that the best financial success
f the farmer can only be secured by the gradual
nat system of manuring the farms.

g dealers in fertilizers begin to realize the late
heir trade, and are preparing to meet the call.
ry reason to assume that the consumption of
nurial matter will increase in the same propor-
inciples of a rational and economical system of
come better understood.

s of an examination and a discussion of all ferti-
der a special license are reported according to
ws, by the inspector, to the State Board of
and will be found in the report of the Secretary
for 1884.

Ammonium Sulphate.

f D. A. Horton, Northampton, Mass. Guaranteed 25 per cent. of ammonia.]

examination by M. W. Jefts, for the Ashby Farmers' Club, Ashby, Mass.]

	Pounds per Hundred.	
	I.	II.
° C., ...	1.88	0.42
. . . . .	25.07	24.00
,000 lbs., ...	$90 64	$87 12

of this article has varied widely at times; the
ased on our annual rate, 22 cents per pound of
nmonia salts.

Chili Saltpetre.

[Collected at Amherst, Mass.]

C.,°	1.98
ric acid), ...	14.44
,000 lbs., ...	$51 98

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Muriate of Potash.

[I. Sent on by M. W. Jefts, for Ashby Farmers' Club, Ashby, Mass.]

[II. Collected of Boston Fertilizer Co., by C. P. Preston, Danvers, Mass.]

[III. Collected of Bowker Fertilizer Co., at Amherst, Mass.]

	Pounds per Hundred.		
	I.	II.	III.
Moisture at 100° C.,	1.00	0.05	0.90
Potassium oxide,	51.94	49.60	50.80
Valuation per 2,000 lbs.,	$44 15	$42 16	$43 18

This form of potash compounds has proved to be one o the most reliable potash resources for field and garden.

Kainite.

[Collected of D. A. Horton, Northampton, Mass.]

Moisture at 100° C.,	2.1
Calcium oxide,	.8
Magnesium oxide,	11.3
Potassium oxide,	16.4
Sulphuric acid,	21.9
Valuation per 2,000 lbs.,	$14 0

This is a fair sample of its kind. Potash, in form o kainite, has been applied with much success for forag crops. It deserves a careful trial upon pastures and mead ows, in connection with bone fertilizers.

Refuse Salt.

[Collected of R. T. Prentiss, Holyoke, Mass.]

Moisture at 100° C.,	1.7
Calcium oxide,	1.2
Magnesium oxide,	.4
Sulphuric acid,	1.5
Sodium chloride,	95.3

The article is a fair specimen of its kind. A detailed discourse of the various kinds of salt used for agricultura purposes, etc., may be found in the annual report of the Mas sachusetts State Board of Agriculture for 1869, page 18.

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Crude Kieserite.

r Co., Boston, Mass. Sent on by C. P. Preston, Danvers, Mass]

. . . . .	28.12
. . . . .	17.45
. . . . .	3.13
. . . . .	36.87
. . . . .	3.62

ontained 48.6 per cent. of sulphate of mag-
8 per cent. of gypsum, and 2.23 per cent.
agnesium; it is consequently of fair quality.
s an absorber of ammonia, may profitably be
stances as a substitute for gypsum.

Nova Scotia Plaster (Gypsum).

Collected of R. T. Prentiss, Holyoke, Mass.]

	Pounds per Hundred.
. . . . .	32.17
. . . . .	1.40
. . . . .	44.00
. . . . .	.70

contains 94.8 per cent. of gypsum, and is a
e customary market price in our vicinity is

Onondaga Plaster (Gypsum).

ted of Sheldon & Newcomb, Greenfield, Mass.]

	Pounds per Hundred.
. . . . .	29.15
. . . . .	3.89
. . . . .	31 82
. . . . .	9.25

ells at $6 per ton; its cost corresponds well
age of gypsum, — 67 to 68 per cent.

Onondaga Plaster.

llected of H. D. Fearing, Amherst, Mass.]

	Per cent.
. . . . .	22.25
. . . . .	29.80
. . . . .	4.32
. . . . .	31.58
. . . . .	8.80
. . . . .	10.70

contains a considerable amount of carbonate

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of lime, and resembles closely the previous one, where special determination of carbonic acid has been recorded.

Lime-Kiln Ashes.

[I. Collected of R. T. Prentiss, Holyoke, Mass.]
[II. Collected of J. A. Sullivan, Northampton, Mass.]

	Pounds per Hundr	
	I.	II.
Moisture at 100° C.,	30.70	20.
Calcium oxide,	37.55	45.
Magnesium oxide,	3.68	1.
Potassium acid,	1.70	1.
Phosphoric acid,	1.27	2.
Carbonic acid,	17.83	21.
Sulphuric acid,	–	
Insoluble matter,	3.30	8.

I. These ashes sold at 22 cents per bushel.

II. Sold at 18 cents per bushel at retail, and 12½ ce per bushel by the car-load. They consist in the main c mixture of carbonate and slacked lime.

Wood Ashes.

[I. Ashes sent on for examination from Northfield, Mass.]
[II. Western ashes (leached) sent on for examination from Hingham, Mass Edmund Hersey, for the Hingham Agricultural and Horticultural Society.]

	Pounds per Hundr	
	I.	II.
Moisture at 100° C.,	27.47	24.
Calcium oxide,	30.50	26.
Magnesium oxide,	2.81	3.
Potassium oxide,	1.25	
Phosphoric acid,	1.98	1.
Insoluble matter,	10.55	21.

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ught to be bought and sold on guaranty of
nferior wood ashes are liable to come from all
country.

tion of the sample of leached ashes (No. II.)
ely that of a previously reported one from
(See Bulletin 5, No. 108; or First An-
ge 102.)

shes, sent on by H. C. Haskell, of Deerfield, Mass.]
hes, sent on by Edmund Hobart, North Amherst, Mass.]

	Pounds per Hundred.	
	I.	II.
., ...	15.37	28.57
. . . . .	84.63	71.43
. . . . .	35.65	27.02
. . . . .	3.64	5.06
. . . . .	2.38	2.75
. . . . .	2.11	1.07
. . . . .	7.95	9.34

Ashes.

by Messrs. John B. Moore & Son, Concord, Mass.]

	Per cent.
., ...	8.60
. . . . .	35.80
. . . . .	4.25
. . . . .	3.91
. . . . .	2.01
. . . . .	16.08

Fertilizer.

t on by W. H. Earl & Co., Worcester, Mass.]

	Per cent.
., ...	26.20
. . . . .	28.15
le matter, ...	71.85
. . . . .	20.59
. . . . .	.45
. . . . .	2.63
. . . . .	1.95

en in this material is present in the form of

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leather refuse which has been treated with lime, no valuatio
is stated, as it must be valued by testing in the field.

Ground Horn.

[Of Perkins & Bradstreet, Danvers, Mass. Sent on for examination by J. J. H
Gregory, Marblehead, Mass.]

Moisture at 100° C.,	10.00
Organic and volatile matter,	95.00
Ash,	5 00
Phosphoric acid,	1.36
Nitrogen in organic matter,	13.53

Valuation per 2,000 Pounds.

270.6 lbs. nitrogen at 10 cents,	$27 06
27.2 lbs. phosphoric acid at 4½ cents,	1 22
	$28 28

The inferior mechanical condition of the article advises th
low valuation of the nitrogen present.

Boneblack.

[I. Collected of B. F. Bridges, South Deerfield, Mass.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	1.55	2.50
Phosphoric acid,	30.54	23.47
Ash,	80.85	58.45
Calcium,	45.73	–
Valuation per 2,000 lbs.,	$27 49	$21 12

Boneblack refuse, in a fine ground condition may be pro
fitably used for composting.

Ground South Carolina Phosphate.

[Sent on by the Ashby Farmers' Club, Ashby, Mass.]

	Per cent.
Moisture at 100° C.,	1.90
Total phosphoric acid,	27.13
Insoluble matter,	11.90
Valuation per 2,000 lbs.,	$12 21

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the phosphate last mentioned depends largely
al condition.

Dissolved Boneblack.

M. W. Jefts, for the Ashby Farmers' Club, Ashby, Mass.]

[II. Sent on for examination.]

	Pounds per Hundred.	
	I.	II.
C.,	11.05	10.50
acid,	18.87	18.48
ic acid,	17.83	16.18
ric acid,	.53	.78
oric acid,	.51	1.52
	.83	.70
00 lbs.,	$37 26	$35 58

Lobster Shells.

xamination by J. Shedd, 90 Waltham St., Boston, Mass.]

C.,	7.27
	22.24
	1.30
	3.52
	4.50
	.27

sent on consisted of coarse pieces of shells
ss in a dry condition. The large percentage
f lime present tends to promote a rapid de-
the organic nitrogenous matter, and favors
action of the lobster shells, when dried and
their application. Counting phosphoric acid
y ground material 4½ cents per pound, and
nts per pound, its commercial value would be
3 per ton.

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Ground Bones.

[Sent on by farmers near Bolton, Mass.]
[I. Coarse Bones.]
[II. Fine Ground Bones.]

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	5.67	5.6
Ash,	67.75	64.7
Total phosphoric acid,	27.17	25.9
Reverted phosphoric acid,	7.21	7.0
Insoluble phosphoric acid,	19.98	18.9
Nitrogen,	3.51	3.2
Insoluble matter,	2.28	.6
Valuation per 2,000 lbs.,	$45 00	$42 6

Penguin Island Guano.

[Sent on for examination.]

Guaranteed composition: Bone phosphate, 51.76 p cent. (equal to 23.07 phosphoric acid); ammonia, 1.43 p cent. (equivalent to nitrogen 1.18 per cent.).

Moisture at 100° C.,	1
Total phosphoric acid,	2
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	1
Potassium oxide,	
Nitrogen in organic matter,	
Nitrogen in ammonia salts,	
Nitrogen in nitrates,	
Total nitrogen,	
Valuation per 2,000 lbs.,	$31

This article deserves a careful trial upon lands rich in ganic matter; in particular, upon moist grass lands.

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Cuba Guano.

[Sent on from Boston. Mass.]

d parts contain : —

	Raw. Per cent.	Dried. Per cent.
C.,	36.57	22.57
acid,	11.34	13.73
ric acid,	.89	1.06
oric acid,	3.52	4.45
horic acid,	6.93	8.22
,	.94	1.20
ganic matter),	.87	1.48
monia salts),	.14	.26
rates),	.64	1.00
000 lbs.,	$24 00	$34 49

Bat Guanos.

	Pounds per Hundred.			
	I.	II.	III.	IV.
	25.47	61.90	72.38	7.80
atile matter,	90.00	90.13	95.66	27.85
,	10.00	9.87	4.34	72.15
acid,	4.43	2.28	1.00	2.04
ganic matter),	5.66	2.21	2.32	.34
monia salts),	3.42	1.49	–	–
rates),	1.80	1.13	.34	.24
,	1.31	–	–	–
,	1.45	3.69	1.91	54.15
000 lbs.,	$48 34	$21 33	$10 80	$4 53

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Fish Fertilizers.

[Sent on for examination from Danvers, Mass.]

[I. Claimed to be chemically prepared fish.] [II. Claimed to be clear fish waste

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	7.70	9.00
Total phosphoric acid,	8.15	11.72
Soluble phosphoric acid,	.67	–
Reverted phosphoric acid,	3.19	4.41
Insoluble phosphoric acid,	4.29	7.31
Potassium oxide,	.89	–
Nitrogen (in organic matter),	8.13	8.16
Insoluble matter,	14.65	3.70
Valuation per 2,000 lbs.,	$45 51	$49 35

Special Corn Mixture.

[Sent on by Gould & Co., Medfield, Mass.]

	Pounds per Hundre
Moisture at 100° C.,	7.82
Ash,	72.25
Total phosphoric acid,	18.09
Soluble phosphoric acid,	1.22
Reverted phosphoric acid,	1.61
Insoluble phosphoric acid,	15.26
Potassium oxide,	2.78
Nitrogen,	2.38
Insoluble matter,	8.40
Valuation per 2,000 lbs.,	$30 75

Garden Fertilizer.

[Sent on by farmers from Somerset, Mass.]

	Per cent
Moisture at 100° C.,	6.64
Soluble phosphoric acid,	.70
Reverted phosphoric acid,	2.12
Insoluble phosphoric acid,	8.26
Total phosphoric acid,	11.08
Potassium oxide,	11.42
Nitrogen,	4.28
Insoluble matter,	.90
Valuation per 2,000 lbs.,	$39 49

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Fertilizer.

y F. J. Kinney, for the farmers near Worcester, Mass.]

	Pounds per Hundred.
C.,	7.15
	53.05
	46.95
acid,	14.00
ric acid,	11.26
oric acid,	2.38
oric acid,	.36
	1.13
	2.56
	.83
00 lbs.,	$38 17

Tobacco Fertilizer.

Dickinson, Hadley, Mass., through the Secretary of Hampshire, nd Hampden Agricultural Society, Northampton, Mass.]

	Per cent.
C.,	14.65
acid,	12.76
ric acid,	2.97
oric acid,	5.29
oric acid,	4.50
	.77
	23.81
	.89
	7.62
	3.20
00 lbs.,	$51 52

from the West Indies. Sent on by "New England Homestead."]
or French turnips. Sent on by "New England Homestead."]
for round turnips. Sent on by "New England Homestead."]

	Pounds per Hundred.		
	I.	II.	III.
C.,	6.00	10.15	9.73
acid,	29.53	7 35	6.50
ric acid,	–	.86	.83
oric acid,	10.28	2.59	2.29
oric acid,	19.25	3.90	3.38
	–	6.02	4.92
nic matter,	–	2 28	2.24
onia salts,	–	1.95	2.75
	–	4 23	4.99
tile matter,	–	36.85	53.25
	–	63.15	46.75
	8.85	1.95	1.18
00 lbs.,	$35 83	$32 71	$34 06

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Havana Tobacco Stems.

[Sent on by S. G. Hubbard, Hatfield, Mass.]

Moisture at 100° C.,	11.0
Dry matter,	88.9
Crude ash,	13.3
Nitrogen in dry matter,	2.91

One hundred parts of dry matter contained: —

Potassium oxide,	3.7
Sodium oxide,	.2
Calcium oxide,	4.1
Magnesium oxide,	1.5
Phosphoric acid,	.5
Sesquioxide iron,	.1
Valuation per ton of 2,000 lbs. for fertilizing purposes,	$14 28

The valuation is based on the prices of the past ye (1883); it is safe to count one-tenth less at the prices the present year.

Kentucky Tobacco Stems, Ground.

Moisture at 100° C.,	12.18
Dry matter,	87.82
Crude ash (in organic matter),	15.00
Nitrogen (in organic matter),	2.616
Chlorine,	.425
Sulphur,	.275
Potassium oxide (4½ cents),	8.816
Sodium oxide,	.161
Magnesium oxide,	1.395
Calcium oxide,	3.720
Phosphoric acid (6 cents),	.726
Insoluble matter,	1.618
Valuation per 2,000 lbs.,	$17 78

In this case the valuation is based upon prices current 1884. Nitrogen has been valued at 18 cents per poun phosphoric acid at 6 cents, and potash, 4¼ cents. Both these refuse materials from the tobacco industry are qui valuable for manurial purposes.

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te Material from Tanneries in Peabody, Mass.

or the Massachusetts Society for Promoting Agriculture.]

° C.,	63.06
	36.94
anic matter,	1.19
ganic matter,	6.80
ash,	1.14
le in ash,	3.25
in ash,	.17
	.17
in ash,	2.25

en, potash and phosphoric acid contained in the , represent a commercial value of $4.64 per pounds.

ng principle was so completely abstracted, that with some air-slacked lime promises to render uite valuable as a manurial substance for light t in organic matter.

Fresh Water Mud.

South Braintree. Sent on by A. Drew, Esq., Boston, Mass.]

a fairly dried sample: —

° C.,	40.37
	1.27
le,	.29
,	.22
	1.80
,	.26
	1.37
,	18.26

ial in its natural state contains 72 per cent. composition it resembles a fibrous peat, yet it ied, and will yield its nitrogen, etc., more e ton of the analyzed material represents a alue of from $5 to $6.

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Salt Mud.

[Sent on by L. B. Goodwin, So. Duxbury, Mass.]

[I. Sample taken from a dock dug in a salt marsh. The sender states that la quantities of kelp have been unloaded at this dock, and a good deal of eel-grass also deposited.]

[II. Taken from the flats at low-water mark.]

	I.	II.
Moisture at 100° C.,	46.36	60.37
Ash constituents,	49.28	33.09
Insoluble in acids,	43.55	26.20
Nitrogen in organic matter,	.39	.40

Soluble constituents contained: —

Sesquioxide of iron,	4.55	3.70
Calcium oxide,	.66	.90
Magnesium oxide,	.31	.42
Potassium oxide,	.33	.32
Sodium oxide,	.94	.94
Phosphoric acid,	traces.	traces

Black Mud.

[III. From the flats near Weymouth, Mass. Sent on by Thomas A. Watson, Esq.]

Moisture at 100° C.,	56.55
Ash constituents,	39.60
Insoluble in acids,	31 8
Nitrogen in organic matter,	.30

Soluble constituents contained: —

Sesquioxide of iron,	4.20
Calcium oxide,	.91
Magnesium oxide,	.60
Potassium oxide,	.38
Sodium oxide,	.80
Phosphoric acid,	traces

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e deposits of tidal water are of a similar com-
e amount of organic matter present does not
per cent., and the soluble mineral substances
hose found in the water of the ocean. The
alue of plant constituents amounts, at present
of the deposits, in none of them to more than
last-named sample still less.

interested in the composition of the fertilizing
sited and collected along the seashore, the fol-
nces are given: —

Rockweed. See Report of State Board of
1878–79, page 347.

and Musselmud. Report, 1879–80, page

Report, 1882–83, page 407.

Soil from a Diked Marsh at East Salisbury, Mass.

C.,	34.40
atile matter,	92.15
,	7.85
ash,	4.20
f ash,	3.65
nic matter,	1.64
in ash,	.13
in ash,	.26
	1.24

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ON EXAMINATION OF DRINKING-WATER.

One of the first requirements of success on a farm consist in ample supply of a good water. Purity of the wate used, for drinking in particular, is of vital importanc Cities and towns usually have their organizations for the sup ply of water, and they exact certain guarantees regardin the quality furnished for their use. The farmer, living as rule more isolated on his farm, is in this respect largely le to his own counsel. His chances for obtaining good wate from springs, and for protecting his wells against the acce of obnoxious matters by infiltrations and otherwise, are, i the majority of cases, quite favorable, if intelligently turne to account.

A satisfactory supply of a good drinking-water depend in a controlling degree, on a judicious selection of the loc tion of the well designed for the use of the family and f the live stock; and on the personal attention bestowed, fro time to time, on the condition of the latter and its su roundings. Wells may be badly located in the start, or ma become exposed to contamination by subsequent changes the surroundings. Good wells are liable to change for t worse at any time, on account of circumstances too nume ous to state in this connection. To periodically ascerta the exact condition of the well which supplies the wants the family and of the live stock, is a task which no farm can for any length of time discard, without incurring a ser ous risk in health and prosperity. The subject receive quite frequently, but little attention, on account of the fa that the harmful qualities, which an apparently good wat may contain, are disguised, beyond recognition by the u aided senses. Certain delicate chemical tests, aided at tim by microscopical observations, are, in the majority of case

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ole means, in our present state of the sciences, rable information regarding the true character -water can be obtained.

, it must be acknowledged, although of the ortance from a general standpoint, have their They readily indicate the presence of organic give no unfailing decision regarding their ther animal or vegetable, — leaving thus, quite e degree of their harmfulness quite undecided. chemical analysis may be depended upon for purposes, as revealing the presence of objec- ies of the water.

al substances found in drinking-water are of - mineral and organic. Few natural waters are rom mineral matters; nearly all contain small lime, soda, magnesia and iron, — substances e considered harmless in that case. Larger these elements, however, render the water ob- r drinking, and also more or less unfit for cations, as washing and cooking, feeding of us, etc.

mong the dangerous mineral substances which und in drinking-water is the lead. Its pres- y due to the use of lead pipes for conducting n the well to the pump, and elsewhere. Lead us and dangerous poison. Not a trace should n drinking-water. The use of lead pipes for e latter for either of the above stated purposes ictly prohibited by State law. Arsenic and rely met with in natural waters; yet a careless aris green is at any time apt to become most this direction.

e metals — lead, copper and arsenic — are to the animal system, and therefore are the us mineral impurities in drinking-water, though e.

equent source of danger comes evidently from of organic matter, indicating contamination by nal or vegetable substances. Wells are not ound polluted by the gases and liquids emanat-

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ing from sinks, privies, cesspools or barnyards, when apparent conditions would seem to render it impossible.

Much has been written on this subject, yet the necessity for constant warning still remains. No better illustration is needed than the analyses of the samples given below, which were taken, almost at random, in various parts of the State. These analyses have been made according to Wancklyn's process, familiar to chemists, and are directed toward the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals. (For a more detailed description of this method, see Water Analysis, by J. A. Wancklyn and E. T. Chapman.)

The hardness was determined by Frankland's method. (See Frankland's Water Analysis, page 29.)

The presence of chlorine indicates contamination from sinks, privies or sewers, since it occurs abundantly in urinary secretions; but it may be derived from other and less harmful sources, as saline waters, which the test fails to indicate. One conclusion is, however, safe: a water which contains no chlorine is uncontaminated by sewerage. "Free" and "albuminoid" ammonia are the forms in which organic matter is recognized. Ammonia, existing as such in water, is termed "free." This being expelled by distillation, the nitrogen containing organic matter remaining is reduced to ammonia by chemical agencies, and this secondary product is called "albuminoid ammonia."

The per cent. of total solids is obtained by evaporating a known quantity of the sample to dryness and weighing the residue.

Hardness, a rather arbitrary term, signifies that quality of water which prevents the ready formation of lather with soap. It is usually due to the presence of salts of lime or magnesia, which decompose the soap, forming new insoluble compounds. As long as these reactions occur no lather will be formed, consequently the quantity of a standard soap consumed before a permanent lather is obtained, indicates the amount of earthy salts contained in the sample, or its relative degree of hardness. Frankland's scale has been changed to Clark's, the latter being a more popular one.

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Frankland's scale are equivalent to seven of

n's interpretation of the results of his mode
are as follows: —
e *alone* does not necessarily indicate the
y water.
d albuminoid ammonia in water without
s a vegetable source of contamination.
an five grains per gallon of chlorine, accom-
than 0.08 parts per million of free ammonia
one-tenth parts per million of albuminoid
clear indication that the water is contami-
ge, decaying animal matter, urine, etc., and
mned.
one-hundredths parts per million of free
one-tenth parts per million of albuminoid
a water very suspicious, even without much

noid ammonia, over 0.15 parts per million,
n the water which contains it absolutely.
al solids found in the water should not ex-
s per gallon.
ion of the subsequent results of analysis
alf of the samples should be condemned.

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ANALYSES OF DRINKING-WATER.

	Results in Parts per Million and Grains per Gallon (Imperial.)					Results Expressed in Parts per 100,000.				
	Parts per Million.		Grains per Gallon.							
	Free Ammonia.	Albumonoid Ammonia.	Chorine.	Solids.	Hardness. (Clark's Degrees.)	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids.	Hardness.
Sample No. I.,	.02	.10	.2	Not det.	.89	.002	.01	.287	Not det.	1.27
No. II.,	.60	.48	Not det.	"	Not det.	.06	.048	Not det.	"	Not det.
No. III.,	.06	.26	"	"	"	.006	.026	"	"	"
No. IV.,	–	.14	2.30	"	2.46	–	.014	3.290	"	3.515
No. V.,	.03	.14	.50	"	Not det.	.003	.014	.714	"	Not det.
No. VI.,	2.41	.05	3.20	"	4.90	.241	.005	4.571	"	7.000
No. VII.,	1.51	.37	1.70	13.50	2.28	.151	.037	2.429	19.286	3.257
No. VIII.,	.03	.16	.30	5.75	1.82	.003	.016	.429	8.214	2.600
No. IX.,	29.10	2.20	9.40	Not det.	Not det.	2.91	.220	13.429	Not det.	Not det.
No. X.,	3.20	.40	3.75	"	"	.320	.040	5.357	"	"
No. XI.,	.11	.16	.50	"	1.37	.011	.016	.714	"	1.957
No. XII.	.01	.37	4.45	25.50	10.20	.001	.037	6.357	36.429	14.843

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No. XIX.,	.07	.30	4.00	24.00	5.00	.007	.030	5.714	34.286	7.143
No. XX.,	.06	.15	1.70	5.41	2.91	.006	.015	2.429	7.729	4.157
No. XXI.,	.05	.11	1.70	22.50	7.74	.005	.011	2.429	32.143	11.057
No. XXII.,	.21	.20	1.30	9.00	2.55	.021	.020	1.857	12.857	3.643
No. XXIII.,	.66	.36	7.50	60.00	13.00	.066	.036	10.714	85.714	14.571
No. XXIV.,	.50	.36	14.50	83.00	16.50	.050	.036	20.714	118.571	23.571
No. XXV.,	.34	.16	12.90	52.00	11.80	.034	.016	18.429	74.286	16.857
No. XXVI.,	.01	.07	.70	Not det.	2.50	.001	.007	1.000	Not det.	3.571

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METEOROLOGY.

The importance of meteorological data in connection observations upon plants or animals is apparent to all. conclusions based on such observations are firmly grou until the conditions of temperature, moisture and sun have been duly considered. The weather, therefore, stitutes an important factor in all experiments with anim vegetable organisms.

To supply these useful and necessary facts the station provided itself with the ordinary meteorological instrum for measuring temperature, rainfall, relative humidity of air, etc., uniform with those in use by the United St Signal Service. These comprise an ordinary exposed t mometer, hygrometer, maximum and minimum self-regi ing thermometers, and rain and snow gauges. thermometers are of high, standard quality, of which names of the makers — Messrs. J. & J. H. Green of York, — are sufficient guarantee. These are placed small thermometer house, specially constructed for the pose, with sides of open shutters, five feet above the su of the ground, and at sufficient distance from any build or trees to allow free exposure toward all points of the pass.

Three times daily, at 7 A. M., 2 P. M., and 9 P. M., temperature and relative humidity of the air, amount direction of clouds, direction and force of wind, state of weather, and amount of rain, if any has fallen, are recor In addition to these observations, the maximum and m mum temperatures for the previous twenty-four hours recorded at 9 P. M. These tri-daily observations give a complete record of meteorological phenomena.

The station has become a "voluntary observer" in operation with the Signal Service, and forwards to deparment a duplicate record of observations for each mo receiving in return its Farmer's Daily Weather Bulletin, publications. The bulletins are posted in a conspic

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efit of all who may choose to examine them, eceipt of warning from the Central Signal of this district, a cold wave flag is displayed n buildings. This method of forewarning approach of serious changes of temperature ood and appreciated, and will, we believe, value in the spring and fall months.

cal summary for Amherst, for 1884, is pre- rough the courtesy of Miss S. C. Snell, erst College. It will serve a general pur- well, though taken at a location and g from those of the Station by so much that rences in rainfall and extremes of temperature st. A record of the rainfall at the Station e year bears out this supposition, as the fol- on shows: —

MONTH.	Rain at Amherst College.	Rain at Experiment Station.
	Inches.	*Inches.*
. . . . .	2.02	2.02
. . . . .	1.38	2 11
. . . . .	3.75	3.98*
. . . . .	5.10	4.21
. . . . .	1.25	1.04
. . . . .	2.40	2.06
. . . . .	2.53	2.62
. . . . .	–	–
months, ...	–	–

two places of observation are only about the monthly rainfall agreed in only one ne instance (August) differed 0.89 of an

tive record, incomplete as it is, strongly necessity of obtaining meteorological data e locality of the scene of the experiments. even an adjoining neighborhood do not rements at all, and this is especially true in ountry like that surrounding Amherst.

ts above mentioned will therefore prove an on to our resources.

* Incomplete.

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METEOROLOGICAL SUMMARY FOR AMHERST, MASS., 1884.

[From the Records of Miss S. C. Snell.]

MONTH.	Temperature.			Winds. Percentage from each quarter.				Relative Humidity.			Rain and Melted Snow.	Snow.
	Mean.	Maximum.	Minimum.	N.W. to W.	S. W. to S.	S. E. to E.	N. E. to N.	Mean.	Maximum.	Minimum.		
											Inches.	*Inches.*
January,	21.64	40.1	8.0	47	35	15	3	72	100	41	3.598	2.0
February,	30.86	46.0	5.1	39	20	30	11	77	100	22	4.623	9.5
March,	32.89	54.0	–	48	24	15	13	70	100	34	5.669	4.0
April,	46.69	70.3	31.2	43	18	14	25	63	93	22	2.491	10.0
May,	57.35	85.2	37.6	52	22	18	8	65	90	13	2.020	–
June,	69.10	92.5	50.0	27	36	35	2	69	95	27	1.383	–
July,	68.64	93.0	57.1	53	19	22	6	75	97	40	3.746	–
August,	69.25	92.4	48.8	40	25	32	3	79	–	–	5.095	–
September,	64.35	90.0	39.0	31	39	27	3	77	97	40	1.253	–
October,	50.27	78.2	26.5	48	26	15	11	74	97	33	2.395	–
November,	38.43	61.0	19.8	53	27	17	3	71	95	29	2.530	0.5
December,	30.00	57.0	10.0	53	14	21	6	40	100	–	5.576	11.5

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January,	-	4.21	20.26	1.75	31.99	2.45	24.56	1.66	14.45	3.15
February,	-	3.83	26.69	2.42	19.55	1.67	29.79	1.75	28.50	2.03
March,	32.68	3.13	33.70	2.65	36.35	1.69	37.54	1.69	34.97	3.18
April,	47.27	1.98	47.42	4.33	40.72	2.02	52.18	4.14	48.95	3.98
May,	61.36	2.59	57.88	5.76	54.32	3.63	60.71	3.49	57.06	1.91
June,	66.37	3.45	68.15	4.49	68.63	4.90	65.40	3.30	65.50	4.60
July,	73.62	6.02	70.64	7.35	71.86	2.27	74.40	9.56	70.56	3.34
August,	68.00	0.96	68.61	2.57	68.16	3.95	70.74	2.51	70.26	6.82
September,	62.36	2.28	61.42	1.07	62.73	6.38	63.50	2.82	57.22	5.20
October,	47.88	3.02	49.97	2.06	46.53	4.12	53.32	1.78	47.39	5.04
November,	38.22	3.49	40.23	1.90	34.07	5.77	36.65	3.04	36.95	4 61
December,	29.24	5.80	27.62	2.35	23.52	0.96	28.93	7.09	23.61	3.15
Means and sums,	52.70	40.76	47.72	38.70	46.52	39.81	49.81	42.83	46.28	47.01

* Observations taken, for average temperature, at 9 o'clock, A. M. and 3 o'clock, P. M.

† Observations of average temperature taken at 7 o'clock, A. M. and 6 o'clock, P. M.

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Abstract from the Weather Record — Continued.

MONTHS.	1841.*		1842.*		1843.*		1844.*		1845.†	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	25.63	5.80	25.55	1.02	29.73	1.99	13.93	3.44	24.52	4.97
February,	20.20	1.50	30.50	3.78	16.48	3.49	22.07	2.18	24.86	3.37
March,	31.90	2.85	37.69	2.39	24.52	5.73	35.53	4.12	36.93	3.56
April,	41.63	4.52	46.50	2.92	44.63	4.82	51.95	0.57	45.59	1.70
May,	54.39	3.47	52.71	2.40	55.95	2.09	57.85	5.59	56.15	2.42
June,	68.35	1.65	64.10	3.18	65.28	5.18	65.55	3.00	66.71	2.57
July,	69.53	2.55	71.48	1.95	68.76	2.53	68.23	3.81	72.12	3.31
August,	69.82	3.18	69.05	7.42	69.81	9.38	68.00	4.93	71.54	2.79
September,	61.21	3.50	57.43	3.23	61.70	1.57	59.55	1.84	58.30	2.58
October,	42.81	3.73	47.44	2.84	44.98	9.45	47.55	6.49	49.64	4.66
November,	35.28	2.80	35.10	3.73	33.98	3.07	35.73	2.12	41.49	3.90
December,	29.50	6.08	24.18	3.19	27.97	2.28	27.28	2.49	21.53	3.91
Means and sums,	45.85	41.63	46.81	38.05	45.32	51.58	45.94	40.58	47.45	39.74

* Observations in temperature taken at 7 o'clock, A. M. and 6 o'clock, P. M.

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January,	24.75	2.74	25.50	4.86	28.95	2.92	20.02	0.99	25.90	4.75
February,	20.14	2.55	24.71	4.88	23.71	2.60	18.50	0.99	28.42	3.56
March,	36.33	4.35	29.24	3.57	32.63	3.03	35.37	4.21	32.43	1.86
April,	50.06	1.54	43.28	1.41	43.32	1.55	43.49	2 24	42.91	3.93
May,	58.29	4.33	57.48	1.91	59.47	6.18	53.42	3.61	53.38	8.72
June,	64.96	3.10	64.73	4.44	67.63	2.58	66.88	1.53	67.27	2.88
July,	70.66	3.25	72.42	4.48	69.45	4.72	72.09	2.25	72.08	6.81
August,	69.60	2.44	69.27	4.06	70.56	1.53	68.85	7.86	67.10	6.50
September,	65.48	0.47	59 30	3.63	57.43	2.49	60.05	1.40	59.40	4.93
October,	47.59	2 09	45 97	3.99	47.31	3.15	47.03	6.36	48.18	3.65
November,	43.05	4.96	43.15	4.17	33.49	3.09	44.08	3.65	39.95	2.63
December,	25.32	3.10	34.24	6.41	30.56	5.54	28.40	3.36	23.45	5.37
Means and sums,	48.02	34.92	47.44	47.81	47.04	39.38	46.52	38.45	46.71	55.50

* Observations in temperature taken at 7, 8 or 9 o'clock, A.M., and 6 o'clock, P.M.

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Abstract from the Weather Record — Continued.

MONTHS.	1851.*		1852.†		1853.†		1854.‡		1855.‡	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	23.79	1.66	19.57	2.415	24.26	2.107	22.75	2.007	27.26	5.061
February,	27.89	5.08	25.17	3.349	26.72	6.686	21.96	4.530	19.83	2.702
March,	35.51	1.28	30.86	3 256	33.82	2.391	31.62	3.105	31.53	1.078
April,	46.20	4.43	39.44	4.711	44.02	3.786	43.47	8.328	43.83	3.845
May,	55.61	4.07	56.05	2.295	56.70	5.404	59.49	3.193	56.65	1.492
June,	63.60	3.69	65.38	2.544	66.97	2.636	66.67	1.751	65.04	5.191
July,	69.13	4.31	69.95	3.381	68.73	3.585	74.08	3.525	70.87	6.102
August,	66.20	3.03	65.16	5.190	67.84	7.126	68.82	0.988	65.53	2.553
September,	60.93	2.05	58.37	2.475	59.54	5.664	61.50	5.458	60.82	0.547
October,	51.04	5.43	49.31	1.763	46.84	3.747	51.53	2.305	49.73	10.078
November,	34.54	5.30	36.42	6.426	39.14	6.238	40.27	7.480	38.84	4.123
December,	20.13	3.17	32.85	4.876	26.31	1.834	22.29	2.390	28.21	5.499
Means and sums,	46.21	43.50	45.71	42.681	46.65	48.240	46.99	45.560	46.52	48.181

* Observations in temperature taken at 7, 8 or 9 o'clock, A.M., and 6 o'clock, P.M.
† Observations in temperature taken at 6 o'clock, A.M., and 2 and 10 o'clock, P.M.

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	F.	Inches.	F.	Inches.	F.	Inches.	F.	Inches.	F.	Inches.
January,	15.24	2.483	13.54	3.547	28.81	3.519	22.94	4.887	26.52	1.210
February,	19.02	0.788	31.42	2.407	20.59	1.604	25.59	3.540	24.83	2.964
March,	25.88	1.118	31.08	2.121	31.31	0.795	36.74	6.272	37.19	1.582
April,	46.44	2.510	41.01	7.683	44.37	3.197	43.45	2.962	43.99	1.277
May,	53.58	5.313	55.19	6.818	54.10	2.981	59.19	4.076	57.29	4.573
June,	68.56	1.920	63.63	2.664	66.10	4.620	62.80	6.157	65.22	3.566
July,	72.93	1.955	70.87	4.962	69.80	6.726	67.73	2.607	66.39	6.125
August,	66.19	12.132	67.22	3.140	67.90	4.820	66.43	6.652	68.01	2.676
September,	60.79	3.472	59.90	3.039	50.90	4.135	57.10	4.466	56.78	6.115
October,	48.68	1.403	48.90	3.878	51.42	3.856	45.72	1.853	48.85	2.183
November,	37.47	2.847	39.46	2.069	33.91	2.158	41.07	2.960	42.70	3.521
December,	23.20	4.187	31.47	5.313	25.71	3.161	23.03	4.847	23.87	3.843
Means and sums,	44.84	40.128	46.14	47.661	45.40	41.572	45.98	51.279	46.89	39.655

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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Abstract from the Weather Record — Continued.

MONTHS.	1861.*		1862.*		1863.*		1864.*		1865.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	20.45	4.342	22.31	5.253	29.08	5.053	24.36	2.200	18.73	3.483
February,	29.22	3.284	22.10	2.840	26.29	4.433	28.49	1.115	25.03	2.880
March,	32.49	3.759	32.17	4.298	26.13	5.602	34.40	2.578	37.12	5.980
April,	45.50	5.651	43.55	2.276	45.48	2.329	43.54	2.570	49.01	2.901
May,	53.37	4.449	58.13	2.325	55.35	3.587	60.41	2.541	57.13	7.892
June,	65.48	2.694	63.39	11.687	59.03	4.086	65.70	1.376	69.29	2.939
July,	69.46	5.229	67.98	5.117	70.87	8.636	71.49	0.964	69.06	3.719
August,	65.67	4.102	68.11	2.957	70.07	6.114	70.82	4.401	68.58	1.864
September,	59.93	2.751	61.06	2.118	57.38	2.163	57.84	2.924	65.62	0.373
October,	51.52	4.527	50.96	3.277	49.90	4.035	46.37	2.938	45.97	4.980
November,	37.82	3.981	39.56	4.757	41.06	5.278	38.04	6.197	39.91	2.453
December,	29.00	2.165	27.55	1.911	25.34	4.867	30.18	4.629	28.92	3.536
Means and sums,	46.66	46.934	46.41	48.816	46.33	56.183	47.64	34.433	47.86	42.980

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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	F.	Inches.	F.	Inches.	F.	Inches.	F.	Inches.	F.	Inches.
January,	21.93	1.363	18.30	1.324	20.21	3.519	28.04	3.467	30.78	5.872
February,	26.18	4.617	31.23	3.646	18.21	1.030	28.01	4.137	25.34	5.247
March,	31.64	3.157	30.84	3.115	33.80	3.249	27.28	5.455	30.88	2.709
April,	48.63	2.031	45.49	3.791	41.96	4.270	46.45	1.532	48.26	3.701
May,	54.63	4.480	54.05	4.610	55.13	7.863	55.87	5.649	58.27	1.723
June,	65.82	5.660	67.06	5.672	66.17	2.441	64.72	5.986	70.45	2.728
July,	72.91	4.020	68.14	4.000	73.97	3.284	69.08	2.978	73.55	2.526
August,	63.48	3.955	68.56	9.161	68.97	5.665	66.87	1.039	71.11	2.828
September,	60.00	4.713	59.99	1.107	59.47	10.633	62.06	4.318	62.32	1.752
October,	49.50	3.381	49.90	3.845	45.30	1.371	46.68	11.358	52.02	4.494
November,	40.10	3.859	37.87	4.305	36.48	4.796	35.92	2.591	39.10	3.278
December,	26.30	3.572	22.64	1.511	22.82	1.471	27.48	4.958	28.00	1.840
Means and sums,	46.76	44.808	46.17	46.087	45.21	48.590	46.54	53.466	49.17	38.698

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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Abstract from the Weather Record — Continued.

MONTHS.	1871.*		1872.*		1873.*		1874.*		1875.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	23.27	1.960	25.11	1.507	20.56	5.013	28.15	5.461	16.73	2.896
February,	25.95	2.907	24.16	1.888	24.00	2.174	24.48	2.185	17.53	3.620
March,	40.53	3.988	25.27	2.870	30.64	3.176	32.93	1.348	27.79	4.200
April,	48.00	3.087	45.03	2.201	43.23	1.738	38.32	6.028	40.80	3.329
May,	57.84	3.815	59.14	3.110	54.58	3.910	56.52	5.224	57.14	2.188
June,	65.38	6.575	68.14	3.250	67.48	1.592	66.18	5.059	65.84	2.888
July,	69.18	3.523	72.64	7.066	71.30	2.927	67.16	11.579	69.30	8.149
August,	68.87	6.453	71.60	5.280	67.01	3.468	65.58	2.689	68.94	6.165
September,	52.84	1.302	61.70	6.197	60.35	4.765	62.03	1.818	57.27	4.649
October,	50.95	6.089	48.24	3.639	49.93	6.357	47.60	1.845	47.90	3.887
November,	34.03	3.507	36.43	4.483	29.68	3.509	36.21	3.536	33.11	3.974
December,	24.62	2.668	19.50	2.691	29.23	3.308	29.29	1.168	28.26	1.032
Means and sums,	46.79	45.874	46.41	44.182	45.67	41.937	46.21	47.940	44.22	46.977

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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January,	29.85	2.305	20.05	2.517	25.29	3.575	21.55	1.748	31.60	4.583
February,	26.36	5.526	30.78	0.360	27.14	3.665	22.37	3.490	29.09	3.600
March,	31.60	7.140	33.30	6.973	39.24	2.565	33.00	4.975	33.46	2.680
April,	43.60	3.105	47.80	2.452	52.17	5.853	43.18	3.847	47.54	2.640
May,	57.50	3.956	58.50	1.925	57.38	2.360	60.60	3.317	64.15	1.903
June,	70.61	3.867	67.77	4.587	64.73	6.003	66.26	5.365	68.52	1.401
July,	74.19	4.836	71.13	6.470	73.33	2.163	71.00	5.745	71.81	6.340
August,	70.54	0.272	71.35	2.790	68.63	6.974	67.19	5.885	67.53	2.908
September,	59.10	3.705	63.31	0.910	63.20	2.821	59.02	2.590	63.24	2.686
October,	45.50	1.118	50.50	6.985	54.43	2.054	56.01	1.800	47.27	2.269
November,	40.50	2.488	41.92	5.435	39.11	5.339	37.37	2.350	34.91	2.495
December,	19.70	3.217	33.09	1.023	28.95	6.020	30.83	4.848	22.79	2.287
Means and sums,	47.42	41.499	49.12	42.417	49.47	49.392	47.36	45.960	48.49	35.792

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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Abstract from the Weather Record — Concluded.

MONTHS.	1881.*		1882.*		1883.*		1884.*	
	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.	Temp. F.	Rain. Inches.
January,	17.92	4.011	23.57	5.436	21.00	3.243	21.64	3.598
February,	24.86	1.771	28.19	4.233	25.02	4.027	30.86	4.623
March,	36.20	4.859	35.13	5.200	27.26	1.700	32.89	5.669
April,	43.65	1.645	44.31	1.518	44.29	2.184	46.69	2.481
May,	61.70	4.281	52.86	6.498	58.60	6.195	57.35	2.020
June,	62.77	3.945	66.85	2.251	69.72	3.987	69.00	1.383
July,	70.64	1.501	71.89	1.829	70.42	3.691	68.64	3.746
August,	70.49	2.758	70.89	0.250	66.39	1.573	69.25	5.095
September,	67.35	2.368	63.23	11.846	59.43	3.174	64.35	1.253
October,	52.47	4.239	52.72	1.673	46.82	4.[illegible]08	50.27	2.395
November,	40.30	4.578	36.45	1.330	40.43	1.800	38.43	2.530
December,	36.01	6.148	26.65	1.470	27.02	2.993	30.00	5.576
Means and sums,	48.70	42.104	47.73	43.534	46.36	38.875	48.29	20.369

Average yearly temperature from 1836 to 1884 inclusive, 46.578° F. Average yearly rainfall for same period, 43.532 inches.

* Observations in temperature taken at 7 o'clock, A. M., and 2 and 9 o'clock, P. M.

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ACT FROM THE PREVIOUS RECORDS,

ORTER PERIODS OF THE YEAR, WHICH ARE OF SPECIAL IN-
ICULTURISTS OF THE STATE; I. E., FROM THE 15TH OF APRIL
F JUNE, AND FROM THE 15TH OF AUGUST TO THE 15TH OF

es of Temperature at 9 A. M and 3 P. M.

	Last 15 Days of April.	First 15 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
. .	51.6°	61.9°	59.8°	67.6°	6.74°	63.3°	61.5°	48.9°
. .	50.3	55.1	60.8	68.5	66.9	63.8	58.9	50.3
. .	44.2	54.3	64.0	76.7	70.9	66.5	63.0	55.4
. .	54.1	57.9	63.3	62.7	71.0	66.3	58.7	54.9

f Temperature at 7 o'clock A M. and 6 P. M.

. .	53.93	50.8	63.8	62.8	71.3	60.3	54.1	51.3
.	46.2	47.6	62.0	67.1	68 2	66.1	60.5	45.5
. .	49.4	48.8	59.5	60.8	69.7	63.5	51.7	51.2

A. M. and 3 and 6 P. M. — Averages of 8 A. M. and 3and 6 P M.

. .	52.1	57.5	62.6	63.2	72.6	64.7	63.6	49.7
. .	56.2	60.2	61.3	62.9	68.7	67.6	58.2	51.6
. .	52.1	61.7	58.0	70.7	73.4	63.5	58.8	58.6
. .	58.3	60.9	59.5	69.9	68.3	74.3	61.9	56.9
. .	51.4	57.9	63.2	64.7	69.7	66.4	56.9	49.4
. .	49.3	58.4	66.0	63.6	69.6	64.8	55.4	51.3
. .	46.2	52.5	59.8	65.1	71.8	62.9	59.3	47.9
. .	48.4	53.8	53.7	68.2	66.8	65.6	58.5	51.9
. .	46.3	55.7	64.2	64.1	67.4	70.7	58.2	58.3

f Temperature at 6 A. M. and 2 and 10 P. M.

. .	46.1	53.8	59.3	62.3	70.5	62.9	53.2	52.2
. .	50.3	52.2	61.5	64.9	63.0	64.2	54 5	46.5

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Abstract from the Previous Records — Continued.

Averages of Temperature at 7 A. M. and 2 and 9 P. M.

YEAR.	Last 15 Days of April.	First 15 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days
1854,	46.3	57.3	61.9	66.2	68.1	64.7	54.2	55
1855,	49.7	55.2	58.5	60.9	62.8	63.2	58.4	57
1856,	51.6	49.7	57.9	64.6	62.2	63.0	58.6	52
1857,	41.2	52.7	57.9	62.2	64.4	65.9	53.9	53
1858,	42.2	55.3	52.9	64.2	–	66.2	54.8	52
1859,	41.7	58.2	60.1	59.5	63.2	57.2	57.0	52
1860,	43.3	58.7	59.1	64.0	71.3	58.8	54.7	46
1861,	49.2	51.3	55.6	64.4	60.8	60.9	60.9	53
1862,	49.2	55.9	60.5	62.9	64.6	62.8	59.3	56
1863,	49.4	53.9	63.2	61.8	66.3	62.9	53.8	52
1864,	47.4	58.8	62.1	61.8	66.1	57.9	57.8	48
1865,	51.1	54.5	59.9	67.6	65.0	71.3	60.2	52
1866,	52.4	54.4	54.9	62.1	61.6	63.3	56.7	50
1867,	47.9	50.9	57.3	65.8	66.9	61.9	57.2	49
1868,	48.2	51.6	58.9	63.3	68.8	65.9	53.1	50
1869,	54.7	53.8	58.0	62.4	68.0	63.1	61.0	54
1870,	49.9	56.4	60.2	67.9	68.9	62.0	61.9	56
1871,	48.7	54.2	64.6	67.4	67.4	58.9	52.1	53
1872,	49.7	58.9	59.4	63.8	69.9	62.9	60.4	49
1873,	45.0	51.1	60.9	64.4	64.6	62.3	58.4	50
1874,	39.4	53.3	60.4	64 5	63.6	65.4	59.2	49
1875,	40.4	51.2	64.8	62.8	67.7	63.8	51.1	47
1876,	45.7	53.9	61.3	68.2	67.6	61.2	56.8	46
1877,	51.8	53.6	63.3	67.9	72.4	65.1	61.5	54
1878,	55.9	56.1	59.2	60.7	67.1	68.2	58.6	56
1879,	49.8	58.5	62.7	65.7	65.5	63.8	54.2	61
1880,	50.4	59.7	68.9	64 7	67.3	65.7	62.9	51
1881,	51.1	59.7	60.4	59.9	69.0	67.4	67.1	58
1882,	46.8	49.7	56.2	63.8	66.9	65.6	60.9	54
1883,	42.9	50.8	62.1	69.4	66.7	67.0	58.5	49
1884,	51.3	54.1	61.1	66.6	65.9	67.6	61.1	54

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ct from the Previous Records — Continued.

RAIN.

	Last 15 Days of April.	First 15 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
. .	0.73	1.01	1.58	0.62	0.37	1.08	1.08	2.16
. .	0.18	3.58	2.18	1.51	0.38	0.31	0.76	0.75
. .	1.16	2.45	1.18	2.60	1.06	3.57	2.81	1.64
. .	0.37	2.53	0.96	1.62	1.03	1.03	1.79	1.69
. .	3.10	1.49	0.42	3.54	2.74	0.88	3.90	1.26
. .	2.49	1.65	1.82	0 30	1.78	0.63	2.89	3.60
. .	1.46	0.92	1.48	1.22	4.87	2.99	0.24	1.13
. .	1.45	1.37	0.72	2.41	6.60	1.18	0.39	6.91
. .	0.53	2.02	3.57	1.17	3.28	0.34	1.50	3.37
. .	1.42	0.42	2.00	1.93	1 95	1.48	1.10	4.66
. .	1.35	2.67	1.66	0.22	1.03	0.14	0.33	1.10
. .	1.14	0.77	1.14	1.85	1.24	3.18	0.47	0.67
. .	0.40	4.53	1.65	0.71	1.26	1.15	1.44	2.21
. .	1.76	1.75	1.75	0.69	1.63	0.08	1.34	4.62
. .	2.03	5.18	3.54	1.50	3.43	3.68	1.25	0.91
. .	2.62	2.66	1.41	1.84	2.14	0.68	1.37	1.59
. .	1.14	2.26	0.04	1.17	4.14	1.69	0.78	1.08
. .	1.29	2.79	2.58	0.24	3.89	2.18	3.49	–
. .	7.42	0.98	2.21	0.83	0.51	4.44	1.02	1.90
. .	1.45	0.92	0.57	3.01	1.67	–	0.55	7.18
. .	1.57	3.42	1.89	0.69	3.74	1.47	2.00	0.33
. .	4.68	3.70	3.12	1.03	2.38	0.73	2.31	0.30
. .	1.90	1.65	1.23	3.27	–	3.51	0.62	1.89
. .	1.51	1.40	2.68	2.37	2.01	0.57	3.82	1.53
. .	0.50	0.16	4.41	1.50	0.63	4.28	1.83	1.81
. .	3.21	3.52	0.92	2.16	0.35	1.68	1.07	1.41
. .	1.83	1.76	0.56	6.19	0.47	1.99	0.13	1.56
. .	1.46	3.27	0.21	3.98	4.12	0.10	1.98	2.11
. .	1.12	1.73	0.81	1.38	1.30	0.74	1.79	2.05
. .	0.49	2.59	4.30	1.38	0.33	0.14	0.23	2.04

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Abstract from the Previous Records — Concluded.

YEAR.	Last 15 Days of April.	First 15 Days of May.	Last 15 Days of May.	First 15 Days of June.	Last 15 Days of Aug.	First 15 Days of Sept.	Last 15 Days of Sept.	First 15 Days of Oct.
1866, ...	1.54	1.12	3.38	2.94	1.38	1.28	3.43	0.07
1867, ...	2.80	2.56	2.05	2.72	1.15	0.52	0.59	2.32
1868, ...	1.59	3.64	4 23	1.62	0.65	5.53	5.10	0.67
1869, ...	0.96	3 48	2.17	0.82	0.11	1.18	2.95	10.04
1870, ...	2.71	1.07	0.66	1.13	1.90	0.25	1.51	1.97
1871, ...	2.28	3.53	0.28	2.88	5.12	0.73	0.57	5.13
1872, ...	0.33	1.24	1.82	1.63	3 48	1.01	5.19	1.48
1873, ...	0.55	3.13	0.78	0.34	2.30	1.63	3.14	3.30
1874, ...	4.51	1.62	3.61	1.59	1.90	0.08	1.74	1.78
1875, ...	1.10	1.66	0.33	1.38	2.66	0.81	3.84	1.44
1876, ...	0.52	2.09	1.27	3.43	0.27	0.61	3.10	0.67
1877, ...	1.92	1.12	0.81	3.02	0.35	-	0.91	4.93
1878, ...	4.19	1.48	0.88	2.47	1.62	2.28	0.54	0.33
1879, ...	2.86	1.47	1.85	2.79	4.65	2.21	0.38	-
1880, ...	2.28	0.37	1.53	1.16	1.72	1.70	0.98	-
1881, ...	0.59	0.95	3.33	2.01	0.97	1.13	0.14	1.43
1882, ...	0.89	2.67	3.83	0.76	-	3.81	8.04	0 73
1883, ...	0.55	1.38	4.81	2.33	1.57	0.44	2.73	1.96
1884, ...	0.95	1.09	0.93	0.58	4.69	0.38	0.88	0.50

RECORD OF FROSTS.

YEAR.	Last Frost in Spring.	First Frost in Autumn.	YEAR.	Last Frost in Spring.	First Frost in Autumn.
1836, . .	May 14, .	Aug. 10. / Sept. 6.	1861, . .	May 29, .	Oct. 21.
1837, . .	May 29, .	Sept. 3.	1862, . .	May 25, .	Sept. 3.
1838, . .	May 18, .	Oct. 8.	1863, . .	May 16, .	Sept. 23.
1839, .	May 4, .	Oct. 6.	1864, . .	May 2, .	Sept. 16.
1840, . .	April 28, .	Sept. 13.	1865, . .	May 13, .	Oct. 3.
1841, . .	May 20, .	Oct. 1.	1866, . .	May 15, .	Sept. 16.
1842, . .	May 21, .	Sept. 24.	1867, . .	May 13, .	Sept. 15.
1843, . .	June 1, 2,	Sept. 13.	1868, . .	May 12, .	Sept. 18.

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Record of Frosts — Concluded.

st Frost in Spring.	First Frost in Autumn.	YEAR.	Last Frost in Spring.	First Frost in Autumn.
ay 22, 23,	Sept. 24.	1869, . .	May 23, .	Sept. 1.
ay 31, .	Sept. 13.	1870, . .	May 2, .	Sept. 12.
ay 22, .	Oct. 4.	1871, . .	May 25, .	Sept. 21.
ay 17, .	Sept. 16.	1872, .	May 4, .	Sept. 4.
ay 1, .	Sept. 27.	1873, . .	May 31, .	Sept. 15.
ay 3, .	Sept. 3.	1874, . .	May 23, .	Oct. 5.
ay 22, .	Sept. 30.	1875, .	May 18, .	Sept. 12.
ay 8, .	Sept. 15.	1876, . .	May 23, *	Sept. 28.
ay 3, .	Sept. 17.	1877, . .	–	Sept. 22.
ay 2, .	Sept. 30.	1878, . .	–	–
ay 7, .	Sept. 21.	1879, . .	May 22, .	Sept. 21.
ay 28, .	Sept. 20.	1880, . .	May 15, .	Sept. 24.
ay 6, .	Sept. 25.	1881, . .	–	–
ay 13, .	Sept. 7.	1882, . .	–	Oct. 4.
–	Sept. 25.	1883, .	–	Sept. 4.
ay 16, .	Sept. 16.	1884, . .	May 29, .	Sept. 14.
pril 27, .	Sept. 28.	–	–	–

* No frost 7 A. M. Temperature 41°.

	Last 15 days of April.	First 16 days of May.	Last 15 days of May.	First 15 days of June.	Last 15 days of Aug.	First 15 days of Sept.	Last 15 days of Sept.	First 15 days of Oct.
.	1.73 in.	2.06 in.	1.86 in.	1.81 in.	2.02 in.	1.46 in.	1.84 in.	1.89 in.
.	48.6°	57.0°	60.4°	64.9°	67.5°	64.3°	58.0°	52.4°

last frost in Spring, from 1836 1885, May 16th.
irst frost in Fall, from 1836–1885, September 20th.

C. A. GOESSMANN, *Director.*

ASSISTANTS IN 1884.

Class '83, . . Stock-feeding and Chemical Analysis.*
, Class '83, . . General and Analytical Chemistry.*
ss '83, . . . General and Analytical Chemistry.
, Class '82, . . Biology and Field Experiments.

and Lindsey have since accepted more lucrative positions elsewhere.

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IRD ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

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AT

AMHERST, MASS.

1885.

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OF THE

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1885.

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MASSACHUSETTS STATE

LTURAL EXPERIMENT STATION,

AT AMHERST, MASS.

BOARD OF CONTROL, 1885.

HIS EXCELLENCY GEORGE D. ROBINSON,
Governor of the Commonwealth, President ex officio.

. . . . . Athol.
JS, ... Goshen.
Appointed by the State Board of Agriculture.

. . . . . Marblehead.
, ... Northampton.
d by the Board of Trustees of the Mass. Agricultural College.

YMAN, ... Brookline.
ed by the Massachusetts Society for Promoting Agriculture.

EENOUGH, ... Amherst.
President of the Massachusetts Agricultural College.

S APPOINTED BY THE BOARD OF CONTROL.

EN, *Secretary of the Board*, ... Worcester.
IANN, Ph.D., *Director and Chemist*, . . Amherst.

ASSISTANTS.

ER, B. S.; . . . *General and Analytical Chemistry.*
STONE, B. S., . . *Biology and Field Experiments.*
S., ... *Analytical Chemistry.*
I, ... *Analytical Chemistry.*
ZELL, ... *Farmer.*

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AMHERST, Jan. 12, 1886.

able Senate and House of Representatives.

rd Annual Report of the Board of Control of the cultural Experiment Station at Amherst, for the is herewith submitted, in accordance with the of chapter 212 of the Acts of the year 1882, and 9 of the Acts of the year 1885.

O. B. HADWEN,
Secretary.

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THIRD ANNUAL REPORT

OF THE

R OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

---

orable Board of Control.

EMEN: — The history of the third year of actual the Experiment Station shows some progress in rections. The recently increased appropriation by has rendered it an easier task than heretofore to easonable success of the new institution.

ole changes and improvements in the fitting up of is farm buildings for special purposes, as well as a rough system of general cultivation of the entire nd at the disposal of the Station, can at present be ended to; and the subjects for investigation may be chosen, in part at least, more freely with refer- nmediate practical utility, and in such directions as est of the farming community may point out.

ans for experiments which were from time to time ne past year submitted to your consideration for ent have been carried out to the full extent of the y means on hand. Feeding experiments with milch with pigs have been carried on without much in- n during the entire year. One experiment with tending over a period of six months, to test the value of corn ensilage as compared with other cus- ngredients of a suitable winter diet for dairy stock, experiment with pigs to ascertain the relative feed- t of skim milk and creamery buttermilk, when fed tion with corn meal, are farther on reported. Others ully finished will be published in due time.

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The work in the field has been more extensive and m varied than in previous years. From four to five acre worn-out grass land have been turned over. Part of it ploughed early in the spring, and subsequently, after m uring, planted with fodder corn for ensilage. The remain was added, after harvesting the hay crop, to the exp mental plats for the cultivation of prominent forage crops

The experimental portion of the field work during the year has been described in subsequent pages under the lowing headings: —

1. Fodder corn raised upon underdrained and exhaus lands, partly manured with one single article of plant fo partly without the use of any manurial matter.

2. Influence of fertilizers on the quantity and the qua of some prominent fodder crops.

3. Fodder corn for silos.

4. Observations concerning the adaptation of some pr inent fodder crops new to our section of the country.

5. Experiments with potatoes.

6. Experiments with root crops.

7. Miscellaneous field observations.

Some of these experiments are continuations of inve gations inaugurated in previous years; others are new a tions, and are more or less relating to the question of increased economical supply of fodder, and the rela nutritive character of prominent farm crops.

The examination of fruits with reference to their min constituents, for the purpose of assisting in the introd tion of a rational system of manuring large and small fr bearing plants, has been continued. In this connec several prominent varieties of apples, and of samples apple pomace, have been tested regarding their value fodder for farm live stock. More extensive grounds h been rented from the college for a new orchard, to impr the chance for studying the relation between healthy diseased fruit-bearing plants.

The local weather observations have been continued, though the direct supply of the farmers' bulletins of Signal Service Bureau have been withdrawn.

The work in the chemical laboratory has been quite

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le from a large number of analyses carried on with the feeding experiments, many analyses les, of refuse materials from factories of vari- ns, of agricultural chemicals, of commercial fer- f samples of well water sent on from different tate, have been made at the request of officers bs.

the steadily increasing demand in this direc- ation, it is very desirable, in the interest of and efficient work, that the completion of the y of the Station should be brought about at as possible.

of the farming community in the work of the to be steadily increasing, judging from the n extensive correspondence, as well as the ications for its periodical publications. The pies of each bulletin had to be raised of late and and five hundred.

nce received from all parties connected with e Station, in the laboratory and in the field, satisfactory.

n, permit me to express my sincere thanks to arty support and kind indulgence I have en- lfilment of my duties.

I am, very respectfully,

C. A. GOESSMANN,

Director of the State Agricultural Experiment Station.

, Jan. 12, 1886.

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FEEDING EXPERIMENTS.

C. A. GOESSMANN.

Feeding Experiments with Milch Cows.

The experiments below described were carried on for purpose of ascertaining, under otherwise fairly corresp ing circumstances, the economy of several customary co nations of fodder articles, as far as the cost of the feed the quantity and quality of milk obtained is concerned. observations began on the 1st of November, 1884, and continued until the 18th of April, 1885, extending thus a term of nearly six months.

Two cows, — Lady Horace (grade Ayrshire) and B (grade Jersey), — both from seven to eight years old, of a corresponding milking period, served for the t The last calf had been dropped between the 16th and of October, 1884.

Hay, corn fodder, corn ensilage, corn meal, wheat and gluten meal constituted the ingredients for the compo ing of the daily diet; they were fed periodically, in var proportions and in different combinations, to notice comparative individual merits, if any should become spicuous. The same weights of corn meal, gluten and wheat bran, whenever used, were retained throug the entire experiments; whilst the weight of the hay, fodder and corn ensilage was altered in consequence of b fed either alone or in some particular combination with other. The entire amount of these articles consumed u both conditions was limited in every instance by the i nation of the animal. The first feeding took place bet six and seven o'clock in the morning, the second at n and the third at six o'clock in the evening. Corn n wheat bran and gluten meal were usually fed, together

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ınt of the coarser feed, during milking, morn-
ening, whilst the remainder of the coarser
ffered subsequently three times during the
amount left over was weighed and deducted
previous record. The price which has been
our subsequent valuation of each article of
during the experiments is based on our
on of the market, and does not directly apply
vored localities. The cost of one quart of
ed below, may vary thus, in case of the same
same amount of feed and of a corresponding
lk, from that in other localities. Whilst our
f cost of feed for the production of one quart
only claim a direct application for a limited
vill be conceded that the statement of relative
nilk, in case of different combinations of fodder
ts production, may fairly claim a more general
n. The following rates of prices have been
ur subsequent valuation per ton of two thousand
rn meal and wheat bran, $23.00; gluten meal,
, $15.00; dry corn fodder, $5.00; corn ensilage,
price of the latter is based on the following cir-
well-dried corn fodder contains 20 per cent. of
l 80 per cent. of dry vegetable matter; green
adapted to the production of ensilage, contains
2 per cent. of vegetable matter, and 78 to 82
moisture. Four tons of such green fodder corn
one ton of dry corn fodder, as described.
e ton of green corn fodder worth $1.25, and the
erting it into ensilage equal to $1.50, — a rather
ance, — one ton of corn ensilage would be worth
the relative nutritive value of a fodder article,
the same kind and condition of the animal,
de from its general adaptation, on its actual per-
lry vegetable matter, and on the particular rela-
ion of its nitrogenous (protein) and non-nitrog-
tituents, the total amount of dry vegetable
ined in the entire daily diet during each feeding
een stated, alongside of the daily yield of milk.
proportion of digestible nitrogenous and non-

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nitrogenous constituents of the feed is expressed by "Nu
tive Ratio" taking nitrogen=1. This mode of repor
our observations has been adopted for the purpose of ass
ing the reader in the recognition of the amount of
matter consumed daily by each cow during each period
feeding; and of rendering more conspicuous the effec
each particular combination of fodder articles on the d
yield of milk, as well as the general condition of the anir
on trial.

The weights of the latter were ascertained once each w
before milking and feeding in the morning. Lady Ho
weighs at present 950 pounds, and Bessie 822 pounds, wl
is approximately the same as at the beginning of the exp
ments. The former yields at present from 23 to 24 pou
of milk per day, and the latter from 21 to 22 pounds, v
a daily diet consisting of the same amount of hay, corn n
and wheat bran, which constituted the daily feed during
first feeding period (November 1–10). The decline of n
production (independent of kind and amount of feed)
consequence of the progress of the milking period (s
November 1), amounts apparently to nine pounds per da
the case of both cows. The results obtained confirm
several directions, those reported in previous bulletins (
Nos. 10–11–12; also Second Annual Report, p. 36.) T
show the good service of wheat bran and gluten meal as c
stituents of the daily diet of milch cows, and also the fa
able influence of good corn ensilage on the flow of m
comparing pound for pound of dry vegetable matter
with the yield of milk; yet it is not less apparent that a
exclusive feeding of corn ensilage affects seriously
general condition of the animal. No serious alteratio
the composition of the milk obtained under such conditi
has thus far been noticed; our samples of milk compa
well with the best we have tested from other feed.

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I. Record of Lady Horace.

Consumed (lbs.) per day.					Milk Produced (lbs.) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Nutritive Ratio.	Weight of Animal.
Corn Meal.	Gluten Meal.	Hay.	Corn Fodder.	Corn Ensilage (cut).	Morning.	Evening.	Total.			
3.25	-	20.	-	-	19.3	15.7	35.	23.63	1:8.11	930
3.25	-	20.	-	-	17.1	14.0	31.1	23.63		900
3.25	-	17.4	-	-	15.4	13.5	28 9	21 30	1:7.99	905
3.25	-	18.9	-	-	17 2	13.4	30.6	22.65		985
3 25	3.25	19.	-	-	18.1	14.4	32.5	25.61	1:6.53	992
3.25	3.25	8.3	8.3	-	17.2	12.4	29.6	23.75	1:5.79	944
3.25	-	10.1	10.1	-	15.4	10.9	26.3	24.17		1015
3.25	-	10.3	10.3	-	14 2	10.	24.2	24.53	1:7.01	996
3.25	-	10.7	10.7	-	13.9	10 2	24.1	25.27		1004
3.25	-	4.	-	30.6	14.5	9.9	24.4	14.86	1:7.47	952
3.25	-	-	-	39.1	13.4	9 9	23.3	12.82	1:7.26	905
-	-	-	-	55.	11.6	7.7	19.3	12.85		895
-	-	-	-	49.*	11.3	8.6	19.9	11.12	1:7.	855
-	-	-	-	46.6	11.	8 1	19.1	10.72		876
3.25	-	-	-	36.6	12.	9.1	21.1	9 02	1:8.7	893
3.25	-	20.	-	-	11.1	7.9	19.	20.75	1:9.75	892
-	-	20.	-	-	10.9	7.7	18 6	20 77	1:8.28	935
3.25	-	20.	-	-	12.4	9.7	22.1	23.63	1:8.11	897

ommenced feeding ensilage of uncut corn, Feb. 23.

Analyses of Milk.

	Water.	Solids.	Fat (in solids).	Solids not fat.
. .	86.02	13.98	4.98	9.00
. .	87.15	12.85	3.65	9.20
. .	85.12	14.88	5.10	9.78
. .	87.20	12.80	3 74	9.06
. .	87.26	12.74	3.86	8.88
. .	86 22	13.78	4.70	9.08
. .	87.41	12.59	3.64	8.95
. .	87.05	12.95	3.95	9.00
. .	86.54	13.46	3.97	9.49
. .	86.28	13.72	4.53	9.19
. .	86.95	13.05	3.30	9.75
. .	86.52	13.48	4.90	8 58
. .	85.20	14.80	3.66	10.42
. .	86.36	13.64	4.51	9.13
. .	87.53	12.47	3.58	8 89
. .	86.25	13.75	4 51	9.24

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II. Record of Bessie.

Feeding Periods.	Feed Consumed (lbs.) per day.						Milk Produced (lbs.) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Nutritive Ratio.
	Wheat Shorts.	Corn Meal.	Gluten Meal.	Hay.	Corn Fodder.	Corn Ensilage (cut).	Morning.	Evening.	Total.		
Nov. 1 to 10, .	3.25	3.25	-	19.6	-	-	17.4	14.4	31 8	23.27	1:8.1
11 to 17, .	3.25	3.25	-	20.	-	-	16.1	12.9	29.0	23 63	
18 to 24, .	3.25	3.25	-	15.	-	-	14.3	11 6	25.9	19.16	1:7.76
25 to Dec. 1,	3.25	3.25	-	15 6	-	-	14.9	10.	24.9	19.69	
Dec. 4 to 13, .	3.25	3.25	3.25	14.6	-	-	16.	12.7	28.7	21.22	1:6.1
13 to 23, .	3.25	3.25	3.25	7.4	7.3	-	15.4	11.9	27.3	22.02	1:5.68
24 to Jan. 2,	3.25	3.25	-	7.7	7.7	-	14.8	10.5	25.3	19 80	
Jan. 2 to 12, .	3.25	3.25	-	8.5	8.4	-	14.3	10.	24.3	21.15	1:6.84
13 to 22, .	3.25	3.25	-	8.	8.	-	13.8	9.1	22.9	20.34	
27 to Feb. 3,	3.25	3.25	-	4.	-	36.3	13.7	9.1	22.8	15.90	1:7.64
Feb. 4 to 10, .	3.25	3 25	-	-	-	39.	13.	9.	22.	12.81	1:7.26
16 to 22, .	3.25	-	-	-	-	54.3	11.7	7.	18.7	12.72	
23 to Mar. 1,	3 25	-	-	-	-	50.*	10.4	7.	17.4	11.29	1:6.92
Mar. 2 to 8, .	3.25	-	-	-	-	40.	9.1	7.	16.1	9.61	
13 to 19, .	-	3.25	-	-	-	34.3	8 3	7.	15.3	8.63	1:8.67
24 to 30, .	-	3.25	-	16.3	-	-	9.	7.1	16.1	17.44	1:9.62
31 to Apr. 6,	3.25	-	-	14.6	-	-	9.1	7.	16.	15.94	1:7.78
Apr. 12 to 18, .	3.25	3.25	-	16.	-	-	11.6	9.3	20.9	20.85	1:7.81

* Commenced feeding ensilage of uncut corn, Feb. 23.

Analyses of Milk.

	Water.	Solids.	Fat (in solids).	Solids
Nov. 17, ...	87.00	13.00	4.04	8
24, ...	86.91	13 09	3.86	9
Dec. 5, ...	86.18	13.82	4.02	9
10, ...	86.99	13.01	3.72	9
17, ...	87.41	12.59	3.32	9
23, ...	85.36	14.64	4.75	9
Jan. 7, ...	87.26	12.74	3.76	8
15, ...	87.29	12.71	3.91	8
21, ...	87.89	12.11	3 02	9
Feb. 2, ...	86.92	13.08	4.90	8
10, ...	86.54	13.46	4.11	9
March 5, ...	85.53	14.47	4.74	9
16, ...	87.19	12.81	3.86	8
30, ...	87.15	12.85	3.54	9
April 2, ...	86.81	13.19	4.49	8
13, ...	87 35	12.65	3.74	8

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Cost of Feed per Quart of Milk.

(LADY HORACE.)

Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Dry Corn Fodder Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Gluten Meal Consumed during Period.	Total Cost of Fodder Consumed during Period.	Average Cost of Feed for Production of One Quart of Milk for Period.
Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Cents.*
350.0	35.0	32.5	32.50	200.0	-	-	-	$2 25	1.29
217.7	31.1	22.75	22.75	140.0	-	-	-	1 57	1.44
208.3	28.9	22.75	22.75	121.8	-	-	-	1 44	1.42
214.2	30.6	22.75	22.75	132.3	-	-	-	1 52	1.42
325.0	32.5	32.50	32.50	190.0	-	-	32.50	2 54	1.56
296.0	29.6	32.50	32.50	83.0	83.0	-	32.50	1 95	1.32
263.0	26.3	32.50	32.50	101.0	101.0	-	-	1 76	1.34
242.0	24.2	32.50	32.50	103.0	103 0	-	-	1 78	1.47
241.0	24.1	33.50	32.50	107.0	107.0	-	-	1 82	1.51
195.2	24.4	26.00	26.00	32.0	-	244.8	-	1 18	1.21
163.1	23.3	22.75	22.75	-	-	273.7	-	90	1.11
135.1	19.3	22.75	-	-	-	385.0	-	79	1.17
139.3	19.9	22.75	-	-	-	343.0	-	73	1.05
133.7	19.1	22.75	-	-	-	326.2	-	71	1.06
147.7	21.1	-	22.75	-	-	256.2	-	61	0.83
133.0	19.0	-	22.75	140.0	-	-	-	1 31	1.97
130.2	18.6	22.75	-	140.0	-	-	-	1 31	2.01
154.7	22.1	22.75	25.75	140.0	-	-	-	1 57	2.03

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Cost of Feed per Quart of Milk.

(BESSIE.)

FEEDING PERIODS.	Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Dry Corn Fodder Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Gluten Meal Consumed during Period.	Total Cost of Fodder for Period.	Average Cost of Feed for
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Ce*
Nov. 1-10, . .	318.0	31.8	32.50	32.50	196.0	-	-	-	$2 22	1
11-17, . .	203.0	29.0	22.75	22.75	140 0	-	-	-	1 57	1
18-24, . .	168.0	24.0	22.75	22.75	105.0	-	-	-	1 31	1
25-Dec. 1, .	181.3	25.9	22.75	22 75	109.2	-	-	-	1 34	1
Dec. 4-13, . .	287.0	28.7	32.50	32.50	146.0	-	-	32.50	2 21	1
14-23, . .	273.0	27.3	32.50	32.50	74.0	73.0	-	32.50	1 85	1
24-Jan. 2, .	253.0	25.3	32.50	32.50	77.0	77.0	-	-	1 52	1
Jan. 3-12, . .	243.0	24.3	32 50	32.50	85.0	84 0	-	-	1 60	1
13-22, . .	229.0	22.9	32.50	32 50	80.0	80.0	-	-	1 55	1
27-Feb. 3, .	182.4	22.8	26.00	26 00	32.0	-	290.4	-	1 24	1
Feb. 4-10, . .	154.0	22.0	22.75	22.75	-	-	273 0	-	90	1
16-22, . .	130.9	18.7	22.75	-	-	-	380.1	-	79	1
28-Mar. 1, .	121.8	17.4	22.75	-	-	-	350.0	-	74	1
Mar. 2- 8, . .	112.7	16.1	22.75	-	-	-	280.0	-	65	1
13-16, . .	107.1	15.3	-	22.75	-	-	240.1	-	59	1
24-30, . .	112.7	16.1	-	22.75	114.1	-	-	-	1 12	1
31-Apr. 6, .	112.0	16.0	22.75	-	102.2	-	-	-	1 03	1
Apr. 12-18, . .	146.3	20.9	22.75	22.75	112.0	-	-	-	1 36	1

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Special Analyses of Milk.

the quantity and quality of nitrogenous con-
samples of milk collected before, during and
corn ensilage.

Lady Horace.

	January 21.	February 10.	March 5.
, .	1.0346 at 18° C.	1.0341 at 13° C.	1.032 at 13° C.
.	13.46 per cent.	13.05 per cent.	13.48 per cent.
.	3.97 "	3.30 "	4.90 "
.	9.49 "	9.75 "	8.58 "
.	0.80 "	– –	0.80 "
ein, .	0.43 "	0.29 "	0.31 "
umin,	0.04 "	0.06 "	0.04 "
-Pro-			
,* .	0.05 "	0.11 "	0.06 "
.	0.52 "	0.46 "	0.41 "

ive name for nitrogenous constituents not casein or albumin.

Bessie.

	January 21.	February 10.	March 5.
, .	1.0338 at 16° C.	1.0338 at 16° C.	1.035 at 14.5° C.
.	12.12 per cent.	13.49 per cent.	14.47 per cent.
.	3.02 "	3.72 "	4.74 "
.	9.10 "	9.77 "	9.73 "
.	0.76 "	– –	0.68 "
ein, .	0.40 "	0.30 "	0.43 "
umin,	0.05 "	0.05 "	0.04 "
-Pro-			
,* .	0.06 "	0.10 "	0.07 "
.	0.51 "	0.45 "	0.54 "

ive name for nitrogenous constituents not casein or albumin.

s of these analyses are within the variations
lk of recognized good quality.

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Statement of the Composition of the Various Arti
Fed During the Experiment.

HAY.

[From the Grounds of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	10.55	211.00	–	–
Dry Matter,	89.45	1,789.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	4.69	93.80	–	–
" Cellulose,	29.21	584.20	338.84	58
" Fat,	2.65	53.00	24.38	46
" Protein (Nitrogenous Matter),	9.02	180.40	102.83	57
Non-nitrogenous Extract Matter,	54.43	1,088.60	684.42	63
	100.00	2,000.00	1,150.87	–

The grass was cut the 20th of June, 1884, when in
last stage of blooming. It is of a fair composition.

SHREDDED CORN FODDER.

[From the Experimental Plats of the Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	6.95	139.00	–	–
Dry Matter,	93.05	1,861.00	–	–
	100.00	2,000.00		
Analysis of Dry Matter.				
Crude Ash,	5.16	103.20	–	–
" Cellulose,	33.46	669.20	481 82	72
" Fat,	1.71	34.20	25.65	75
" Protein (Nitrogenous Matter),	12.15	243.00	163.39	73
Non-Nitrogenous Extract Matter,	47.52	950.40	636.77	67
	100.00	2,000.00	1,307.63	

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was cut September 1, 1885, when the kernels milk. The green fodder contained 21.9 per vegetable matter, and had the appearance of a rematurely ripened crop, — a circumstance con- e results of the analysis, which shows a smaller saccharine and starchy constituents than com- ed in this variety of corn (Clark) at the stated wth.

ENSILAGE OF CUT CORN.

corn raised upon Plats of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
0° C., . . .	81.88	1,637.60	–	–	
. . . .	18.12	362.40	–	–	
	100.00	2,000.00			
Dry Matter.					
. . . .	5.07	101.40	–	–	1 : 11.8
e, ...	26.23	524.60	377.71	72	
. . . .	3.49	69.80	52.35	75	
(Nitrogenous r), ...	7.83	156.60	114.32	73	
ous Extract	57.38	1,147.60	768.89	67	
	100.00	2,000.00	1,313 27		

of the silo was carried on during the first and of September, 1884; the mass was covered oards without weights until the temperature in eased to increase. In a few places, about hes below the surface of the mass, the tem- e to 122° F. or 50° C.; whilst taking the entire nsideration, 116° F., or 47° C., represents fairly average temperature attained in our case. The d a slight acid reaction on the second day after corn, and before putting on the final weight ds of sand per square foot, in barrels, as in the ear).

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The silo was opened for the use of its contents on 20th of January, 1885. The ensilage was covered wi mouldy mass, several inches in thickness. This being moved, the remainder proved — although acid to custon reagents — a fair article of its kind, and a decided impr ment on the ensilage of the first trial. This result is lar due to the fact of using corn of a more matured stag growth.

For the details of the production of the ensilage, I refe the Second Annual Report of Experiment Station (188 or Report of the Secretary of the State Board of Agricul for 1884.

WHOLE-CORN ENSILAGE.

[From corn raised upon the Plats of the Experiment Station, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	83.18	1,663.60	–	–
Dry Matter,	16.82	336.40	–	–
	100.00	2,000.00		
Analysis of Dry Matter.				
Crude Ash,	4.23	84.60		
" Cellulose,	29.44	588.80	423.84	72
" Fat,	3.69	73.80	55.35	75
" Protein (Nitrogenous Matter),	9.03	180.60	131.84	73
Non-Nitrogenous Extract Matter,	53.61	1,072 20	718.37	67
	100.00	2,000.00	1,329.40	

The silo was filled with whole corn and covered at o September 1, 1885, as described in detail in the (Second) Annual Report of the Station; it was ope for feeding purposes on the 23d of February, 1885. odor of the fresh ensilage resembled that of the pine a (propionic ether), and turned, within twenty-four hou exposure to the air, into that of vinegar; it had a sl

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n when first exposed. The color was yellowish
ating a good state of preservation; the interior
e uncrushed stems showed the presence of sac-
stituents (glucose); and the kernels in the ear
ill an abudance of starch.

age obtained from whole plants — at once closed
n a better state of preservation than that which
tained from the same quality of corn previously
ces of from 1¼ to 1½ inches in length, and tested
uction of ensilage as described in the previous

anical condition of the whole corn ensilage is
tory for feeding purposes, as far as an economi-
tion of the same weight of both are concerned,
oduced from corn previously cut into pieces of
1½ inches in length.

CORN MEAL.

[Bought of John L. Holley, South Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
0° C., . .	12.62	252.40	–	–	1:8.76
. . . .	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
f Dry Matter.					
. . . .	1.56	31.20	–	–	
se, . . .	2.66	53.20	18.09	34	
. . . .	4.27	85.40	64.90	76	
(Nitrogenous er), . . .	11.43	228.60	194 31	85	
ous Extract	80.08	1,601.60	1,505.50	94	
	100.00	2,000.00	1,782.80	–	

le represents the average composition of the corn
ring the experiment with milch cows.

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WHEAT BRAN.

81.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio
Moisture at 100° C.,	12 05	241.00	–	–	
Dry Matter,	87.95	1,759.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.64	132.80	–	–	
" Cellulose,	11.49	229.80	45.96	20	1:3.77
" Fat,	4.75	95.00	76.00	80	
" Protein (Nitrogenous Matter),	17.86	357.20	314.34	88	
Non-nitrogenous Extract Matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,384.46	–	

GLUTEN MEAL.

99.82 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio
Moisture at 100° C.,	8.45	169.00	–	–	
Dry Matter,	91.55	1,831 00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.76	15.20	–	–	
" Cellulose,	1.73	34.60	11.76	34	1:2.27
" Fat,	9.34	186.80	141.97	76	
" Protein (Nitrogenous Matter),	35.31	706.20	600.27	85	
Non-nitrogenous Extract Matter,	52.86	1,057.20	993.76	94	
	100.00	2,000.00	1,747.76	–	

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FEEDING EXPERIMENTS WITH PIGS.

cond Annual Report, page 68–78 (Bulletin No.
n described the first of a series of feeding exper-
pigs (May 21 to Sept. 22, 1884), which was
he purpose of studying the comparative feeding
n milk from the farm and of buttermilk from
creamery in connection with corn meal, for the
f pork. Equal measures of skim milk and of
ttermilk had been fed, with an addition of a
g weight of corn meal, in each case. Three
n meal for every quart of each kind of milk con-
d the basis for the compounding of the entire
ix) animals on trial. The daily amount of feed
regulated by the appetite of each animal.

y of the results obtained in that connection
—taking corn meal, pound for pound, and skim
amery buttermilk, quart for quart,—practically
ntity of dressed pork had been obtained in both
tating the final weight of each lot of animals—
ber—in one sum; 510 pounds where skim milk
been fed, and 514 pounds in the case of butter-
l. Counting in each case the particular feed
al) with regard to the amount of dry organic
it contained, it was noticed that the buttermilk
ed—taking pound for pound of dry matter of
-the most nutritious article; for 24 pounds of
matter contained in the buttermilk and corn
ad produced, as mean results, one pound of
; whilst in the case of skim milk and meal, 29
organic matter had been spent in the produc-
ound.

animals fed with creamery buttermilk and corn
returned a larger profit, even at the rates of
ach constituent of the diet ruling during the
ing,—May to September, 1884. These results
r of special interest as the skim milk from the
more concentrated and richer article of the two
k fed, according to special chemical analyses
ous times. The skim milk had contained more

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than 20 per cent. more dry organic matter than the cre
ery buttermilk. This circumstance seemed to indicat
waste of skim milk, as compared with the results obtai
in case of the former. As the skim milk was the m
costly article of the feed, a waste of that article cannot oth
wise but seriously affect the cost of the dressed pork obtai
by its use.

In our first experiment—1884—the corn meal was char
$28 per ton at the mill; creamery buttermilk, $1.37 ce
per gallon, the contractor's price; and farm skim milk, t
cents asked for at the farm. Cost of feed per pound
dressed pork at these rates amounted, in case of the cream
milk feed, to 4.6 cents; and in case of the farm skim m
feed, to 5.8 cents per pound.

As a charge of two cents per gallon for skim milk m
be considered somewhat arbitrary, its commercial va
for feeding purposes has been based, with more propriety
our subsequent experiments, on the amount of solid matte
contains as compared with that of the creamery butterm
taking the contractor's price of the latter as the standard.

	Percentage of Solids.		Cost per Gallo	
	1884.	1885.	1884.	188
Creamery buttermilk, ...	7.09	8.00	1.37 cts.	1.37
Farm skim milk, ...	9.58	10.22	1.78 cts.	1.75

A recalculation of the cost of feed consumed in our f
experiment (1884) at the rate adopted in our second exp
ment (1885), described within these pages, does not a
the financial results of that experiment, so far as the relat
cost of each kind of feed is concerned.

Cost of Feed per Pound of Dressed Pork.

	1884.	1885.
Creamery buttermilk and meal, ...	4.6 cts.	4.20 ct
Farm skim milk and meal, ...	5.8 cts.	4.85 ct

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us short discussion of the first feeding experi-
to be necessary in the interest of a desirable
g of the subsequent description of the second
riment, beginning Nov. 5, 1884, and ending
85.

eding Experiment.—Twelve pigs served in this
hich were barrows. Six of them were crosses
sow with Yorkshire boar; their individual
d from 38 to 46 lbs. The remaining six ani-
rosses of Chester White sow with Yorkshire
g from 15 to 19 lbs. each. They were arranged
ment in two lots,— A and B,— each contain-
the former and three of the latter breed. The
nbers in each lot are the heavier animals (Berk-

2, 3, 4, 5 and 6) was fed with creamery butter-
meal, at the rate of three ounces of corn meal
rt of milk consumed, until the quantity of milk
day to meet the individual want of each animal
from twelve to thirteen quarts, when the in-
for the daily diet ceased.

uent still steadily increasing demand for more
plied by a gradual increase of corn meal, rising
four, five, six, and finally to seven and one-
meal for every quart of buttermilk. The ex-
ninated with ninety-two ounces of corn meal to
of milk.

8, 9, 10, 11 and 12) was fed with skim milk
, and corn meal, at the following rates: —
and 9 (Berkshire) received, from the 5th of
to the 9th of December, two ounces of meal
rt of skim milk consumed; from the 9th of
the 15th of January, four ounces of meal to
f milk. The meal was subsequently gradually
t ounces per quart of milk. The consumption
reached ten quarts per day, when the want
necessitated (February 7) a change in the
ding adopted for this lot of pigs. Creamery
d meal — six ounces of meal for every quart of
were substituted; at that period seventy-two

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ounces of meal and twelve quarts of milk were fed. experiment was continued, in the same manner as Nos. and 3 of Lot A, until the 17th of March.

The second half of Lot B (Nos. 10, 11 and 12) rece from November 5 to December 9, two ounces of for every quart of skim milk consumed; from the 9 December to the 14th of January, four ounces; fron 14th of January to the 17th of February, from five to and one-half ounces of meal per quart. At this stage o experiment, when the daily consumption of the milk reached from six to seven quarts, the increase of milk ces The call for additional feed during the remainder of th periment was supplied by a gradual increase of meal, March 25, when the animals were killed. The daily sumption of meal had reached, one week before the clos the experiment, one hundred and eight ounces, or 6¾ in case of every animal of this division of Lot B, w proved to be the most profitable one of the entire ex ment.

The tabular statement which follows aims at a more cise presentation of numerical relations regarding impo points of the entire experiment, as far as every indivi animal as well as each lot is concerned. A summar results, which closes the detailed statements, shows Lot B, on the whole, has given the best returns, with second division leading. The superior quality of the milk (Lot B) is rendered quite conspicuous by a savin three hundred and sixty gallons of milk, and an incre production of one hundred and one pounds of dressed p as compared with the use of creamery buttermilk (Lot with practically a corresponding quantity of meal, u otherwise corresponding conditions.

The results of our first experiment were reversed, as m have been expected, by a more judicious distribution o increased proportion of meal at the various stages of gro The cost of the entire feed consumed by Lot A amounte $51.00, and that of Lot B to $53.02; whilst the cost of for the production of one pound of dressed pork in L amounted to 5.73 cents, and that of Lot B amounted to

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nfluence of a severe winter, and thus gradually
erature, during the second experiment (No-
rch) has no doubt exerted a depressing in-
total results, when compared with the results
periment (May to September).

unds of Dry Matter in Feed required to produce One Pound of Dressed Pork.

	I., 1884. Summer.	II., 1885. Winter.
milk feed, ...	2.4 lbs.	3.67 lbs.
. . . . .	2.9 "	3.33 "

the stated facts, there are some other points of
al character deserving of mention in this con-
are not infrequently underestimated in the
s for the market.

areful preparation of the feed for young pigs,
to a higher nutritious character at the begin-
gradually increasing bulk for the proper dis-
digestive organs, to make them hereafter good
eral supply of milk, with a gradual increase of
g with from one to two ounces of meal per
ed us well.

timely closing up of the fattening process in
profits for the best returns of the feed are ob-
earlier periods of growth; in our case, as a
ere doubtful after the animal reached a weight
o 200 lbs. There may be exceptions to this
hen the cost of feed is low, and the market
ed pork very high, — a circumstance not often
Our dressed pork was sold at 6¾ cents per

tration in this direction may be furnished by
rd of actual results in the case of pigs Nos.
of Lot B (pigs fed with skim milk and meal).

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	Live Weight of Animal at the close of Feeding Period (in pounds).	Gain in Live Weight during Period (in pounds).	One Hundred Pounds of Dry Matter in Feed had produced Live Weight (in pounds).
No. 10. I. Feeding Period, . .	48.5	30.0	82.0
II. " " . .	98.5	50.0	55.1
III. " " . .	152.0	53.5	39.1
IV. " " . .	209.0	57.0	23.8
No. 11. I. Feeding Period, . .	45.5	28.5	77.9
II. " " . .	89.5	44.0	48.5
III. " " . .	138.0	48.5	35.4
IV. " " . .	191.0	53.0	22.1
No. 12. I. Feeding Period, . .	48.0	30.0	82.0
II. " " . .	97 5	49.5	54.5
III. " " . .	147.5	50.0	36.4
IV. " " . .	216.0	68.5	28.6

As the difference of live weight and dressed weight
case here under discussion amounts on an average t
lbs. per hundred weight, and as we sold our dressed p
6¾ cents per pound, we lost money on the feed whene
cost exceeded 5.49 cts. per pound of live weight gain
other words, in only one case, that of No. 12, did we
money during the IV. feeding period of our trial b
verting the feed into live weight. These relations a
most striking in feeding periods of equal length, a
about four weeks' duration. Our younger animals sh
in every case, a larger gain in live weight during th
period of feeding than the heavier ones, showing the a
tage of beginning well at an early stage of growth.

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[A.]

BUTTERMILK AND CORN MEAL

No. 1.

	Total Amount of Meal consumed during Period (in pounds).	Total Quantity of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
								lb. oz.
.	156.8	796 0	137.0	137.1	1:3.5	43.5	144.5	1 4
.	28.0	86.5	24.5	14.9	1:4.	144.5	171.5	3 14
.	118.8	288.0	97.7	49.7	1:4.4	171.5	205.5	1 7
.	102.4	216.0	89.5	37.3	1:4.8	205.5	231.0	1 7

of feed consumed from Nov. 5, 1884, to March 17, 1885, —

Meal, equal to dry matter, ...	349	lbs.
termilk, equal to dry matter, ...	239	lbs.
t of dry matter, ...	588	lbs.
nimal at beginning of experiment, . .	43.5	lbs.
me of killing, ...	231.0	lbs.
ed during experiment, ...	188.5	lbs.
at time of killing, ...	195.0	lbs.
y dressing, 36 lbs., or 16 per cent.		
gained during experiment, ...	159.0	lbs.

nsumed during the experiment, —

al at $22.50 per ton, ...	$4 49
nilk at 1.37 cents per gallon, ...	4 75
	$9 24

matter fed yielded one pound of live weight, and 3.69
r yielded one pound of dressed weight.
or production of 1 lb. of dressed pork, 5.81 cts.

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[A.]

BUTTERMILK AND CORN MEAL.

No. 2.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Jan. 27, .	156.8	796.0	137.0	137.1	1 : 3 5	46.0	156.5
Jan. 27 to Feb. 3, . .	28.0	86.5	24.5	14.9	1 : 4.	156.5	171.0
Feb. 3 to Feb. 27, . .	111.8	288.0	97.7	49.7	1 : 4 4	171.0	220.0
Feb. 27 to March 17, .	102.4	216.0	89.5	37.3	1 : 4.8	220.0	247.0

Total amount of feed consumed from Nov. 5, 1884, to March 17,

399 lbs. of Corn Meal, equal to dry matter, ... 34
1,386 qts. Buttermilk, equal to dry matter, ... 23

Total amount of dry matter, ... 58

Live weight of animal at beginning of experiment, . . 4
Live weight at time of killing, ... 24
Live weight gained during experiment, ... 20
Dressed weight at time of killing, ... 20
Loss in weight by dressing, ... 43 lbs., or 17.5 p
Dressed weight gained during experiment, ... 16

Cost of feed consumed during experiment, —
399 lbs. Corn Meal at $22.50 per ton, ...
346 gals. Buttermilk at 1.37 cents per gal., ...

2.93 lbs. of dry matter fed yielded one pound of live weight; a
lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.56 cents.

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[A.]

BUTTERMILK AND CORN MEAL.

No. 3.

	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
								lb. oz.
.	156.8	796.0	137 0	137.1	1 : 3.5	38.	150.0	1 6
.	28.0	86.5	24.5	14.9	1 : 4.	150.	153 0	0 7
.	111.8	288 0	97.7	49.7	1 : 4.4	153.	198.0	1 14
.	102.4	216.0	89.5	37.3	1 : 4.8	198.	218.5	1 2

f feed consumed from Nov. 5, 1884, to March 17, 1885, —

Ieal, equal to dry matter, ...	349. lbs.
nilk, equal to dry matter, ...	239. lbs.
t of dry matter, ...	588. lbs.
nimal at beginning of experiment, . .	38.0 lbs.
me of killing, ...	218.5 lbs.
ed during experiment, ...	180.5 lbs.
t time of killing, ...	183.0 lbs.
y dressing, ...	35.5 lbs., or 16.13 per cent.
gained during experiment, ...	151.0 lbs.

nsumed during experiment, —

Meal at $22.50 per ton, ...	$4 49
nilk at 1.37 cents per gal., ...	4 75
	$9 24

y matter fed yielded one pound of live weight, and 3.9
r yielded one pound of dressed weight.
r production of one pound of dressed pork, 6.1 cents.

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[A.]

BUTTERMILK AND CORN MEAL.

No. 4.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Jan. 27, .	96	490	84.0	84.5	1 : 3.5	19.0	101.0
Jan. 27 to Feb. 25, .	101	321	88.0	55.3	1 : 4	101.0	135.5
Feb. 25 to Mar. 17, .	88	228	76.7	39.3	1 : 4.4	135.5	161.5
Mar. 17 to Mar. 26, .	53	108	46.2	18.6	1 : 4.8	161.5	165.0

Total amount of feed consumed from Nov. 1, 1884, to March 26,

338 lbs. Corn Meal, equal to dry matter, ... 29
1,147 qts. Buttermilk, equal to dry matter, ... 19

Total amount of dry matter, ... 49

Live weight of animal at beginning of experiment, . .
Live weight at time of killing, ...
Live weight gained during experiment, ...
Dressed weight at time of killing, ...
Loss in weight by dressing, ... 32 lbs., or 19.5 p
Dressed weight gained during experiment, ...

Cost of feed consumed during the experiment, —
338 lbs. Corn Meal at $22.50 per ton, ...
287 gals. Buttermilk at 1.37 cents per gal., ...

3.37 lbs. of dry matter fed, yielded 1 lb. of live weight, and
of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.55 cents

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[A.]

BUTTERMILK AND CORN MEAL.

No. 5.

	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
								lb. oz.
.	96	490	84.0	84.5	1 : 3.5	19	102	1 0
.	101	321	88.0	55.3	1 : 4.	102	148	1 9
.	88	228	76 6	39.3	1 : 4.4	148	188	2 0
.	53	408	46 2	18.6	1 : 4.8	188	198	1 2

t of feed consumed from Nov. 5, 1884, to March 26,

Meal, equal to dry matter, ...	295 lbs.
nilk, equal to dry matter, ...	197.7 lbs.
t of dry matter, ...	492.7 lbs.
nimal at beginning of experiment, . .	19.0 lbs.
me of killing, ...	198.0 lbs.
ed during experiment, ...	179 0 lbs.
t time of killing, ...	161.5 lbs.
y dressing, ...	36.5 lbs., or 18.4 per cent.
gained during experiment, ...	146.0 lbs.

onsumed during the experiment, —

al, at $22.50 per ton, ...	$3 80
nilk, at 1.37 cents per gal., ...	3 93
	$7 73

y matter fed yielded 1 lb. of live weight, and 3.4 lbs. of
d 1 lb. of dressed weight.
r production of 1 lb. of dressed pork, 5.29 cents.

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[A]

BUTTERMILK AND CORN MEAL.

No. 6.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Jan. 27, .	96	490	84 0	84.5	1 : 3.5	15.0	107.5
Jan. 27 to Feb. 25, .	101	321	88.0	55 3	1 : 4.	107.5	155.0
Feb. 25 to Mar. 17, .	88	228	76.7	39.3	1 : 4.4	155,0	191.0
Mar. 17 to Mar. 26, .	53	108	46.2	18.6	1 : 4.8	191.0	198.5

Total amount of feed consumed from Nov. 5, 1884, to March 26, 18

338 lbs. Corn Meal, equal to dry matter, ... 295 0
1,147 qts. Buttermilk, equal to dry matter, ... 197.7

Total amount of dry matter, ... 492.7

Live weight of animal at beginning of experiment, . . . 15.0
Live weight at time of killing, ... 198.5
Live weight gained during experiment, ... 183 5
Dressed weight at time of killing, ... 159.5
Loss in weight by dressing, ... 39 lbs., or 19.6 per
Dressed weight gained during experiment, ... 147.5

Cost of feed consumed during experiment,—

338 lbs. Corn Meal, at $22.50 per ton, ...
287 gals. Buttermilk, at 1.37 cents per gal., ...

2.68 lbs. of dry matter fed yielded 1 lb. of live weight; and 3.3
of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.24 cents.

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[B.]

SKIM MILK AND CORN MEAL.

No. 7.

	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
								lb. oz.
.	24.5	197	21 5	44.7	1 : 2.7	37	69	0 15
.	121.0	452	105.4	102 6	1 : 4	69	160	1 14
.	28.0	70	24 5	15.8	1 : 3.9	160	171	1 9
.	19.0	36	16 4	8.1	1 : 4 3	171	179	2 0
.	196.0	456*	171.4	78.7	1 : 4 7	179	254	2 0

* Buttermilk

of feed consumed from Nov. 5, 1884, to March 17, 1885,—

Meal, equal to dry matter,	339.2 lbs.
Milk, equal to dry matter,	171.2 lbs.
milk, equal to dry matter,	78.7 lbs.
t of dry matter,	589.1 lbs.
nimal at beginning of experiment,	37.0 lbs.
me of killing,	254.0 lbs.
ed during experiment,	207.0 lbs.
t time of killing,	208.5 lbs.
y dressing,	45 5 lbs., or 17 8 per cent.
gained during experiment,	178.0 lbs.

ring experiment, —

Meal, at $22.50 per ton,	$4 37
Milk, at 1.8 cents per gal.,	3 40
rmilk, at 1.37 cents per gal.,	1 56
	$9 33

r matter fed yielded 1 lb. of live weight; and 3.31 lbs. lded 1 lb. of dressed weight.

r production of 1 lb. dressed pork, 5.24 cents.

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[B.]

SKIM MILK AND CORN MEAL.

No. 8.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry-Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Dec. 9, . .	24.5	197.0	21.5	44.7	1:2.7	41.5	74.0
Dec. 9 to Jan. 27, . .	121.0	452.0	105.4	102.6	1:4	74.0	152.5
Jan. 27 to Feb. 3, . .	28.0	70.0	24.5	15.8	1:3.9	152.5	176.0
Feb. 3 to Feb. 7, . .	19.0	36.0	16.4	8.1	1:4.3	176.0	178.0
Feb. 7 to March 17, .	196.0	456.0*	171.4	78.7	1:4.7	178 0	243 0

* Buttermilk.

Total amount of feed consumed from Nov. 5, 1884, to March 17, 18

388.5 lbs. Corn Meal, equal to dry matter, ... 339

755 qts. Skim Milk, equal to dry matter, ... 171

456 qts. Buttermilk, equal to dry matter, ... 78

Total amount of dry matter, ... 589

Live weight of animal at beginning of experiment, . . 41

Live weight at time of killing, ... 243

Live weight gained during experiment, ... 201

Loss in weight by dressing, ... 38 lbs., or 15.6 per

Dressed weight at time of killing, ... 205.

Dressed weight gained during experiment, ... 170.

Cost of feed consumed during experiment, —

388.5 lbs. Corn Meal, at $22 50 per ton, ...

189 gals. Skim Milk, at 1.8 cts. per gal., ...

114 gals. Buttermilk, at 1.37 cts. per gal., ...

2.9 lbs. of dry matter fed, yielded 1 lb. of live weight; and 3.47 l dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork. 5.48 cts.

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[B.]

SKIM MILK AND CORN MEAL.

No. 9.

	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry-Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
								lb. oz.
.	24.5	197.0	21.5	44.7	1:2.7	40.0	77.0	1 1
.	121.0	452.0	105.4	102.6	1:4	77.0	160.5	1 11
.	28.0	70.0	24.5	15.8	1:3.9	160.5	171.0	1 8
.	19.0	36 0	16.4	8.1	1:4.3	171.0	179.5	2 2
.	196.0	456.0*	171.4	78.7	1:4.7	179.5	249.0	1 13

* Buttermilk.

of feed consumed from Nov. 5, 1884, to March 17, 1885,—

Meal, equal to dry matter, ...	339.2 lbs.
Milk, equal to dry matter, ...	171.2 lbs.
milk, equal to dry matter, ...	78.7 lbs.
nt of dry matter, ...	589.1 lbs.
nimal at beginning of experiment, . .	40.0 lbs.
me of killing, ...	249.0 lbs.
ned during experiment, ...	209.0 lbs.
at time of killing, ...	209.0 lbs.
y dressing, ...	40 lbs., or 16 per cent.
gained during experiment, ...	174.5 lbs.

onsumed during experiment, —

Meal, at $22.50 per ton, ...	$4 37
Milk, at 1.8 cts. per gal., ...	3 40
rmilk, at 1.37 cts. per gal., ...	1 56
	$9 33

y matter fed, yielded 1 lb. of live weight; and 3.37 lbs. elded 1 lb. of dressed weight.

r production of 1 lb. of dressed pork, 5.35.

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[B.]

SKIM MILK AND CORN MEAL.

No. 10.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry-Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Dec. 9, . .	13.5	109	11.9	24.7	1:2.7	18.5	48.5
Dec. 9 to Jan. 15, . .	51.0	204	44.5	46.3	1:3.1	48.5	98 5
Jan. 15 to Feb. 17, .	88.0	266	76.6	60 3	1:3.9	98.5	152.0
Feb. 17 to March 25, .	209.0	252	182.5	57.2	1:5.	152.0	209.0

Total amount of feed consumed from Nov. 5, 1884, to March 25, 1

361.5 lbs. Corn Meal, equal to dry matter, ... 315.
831.0 qts. Skim Milk, equal to dry matter, ... 188.

Total amount of dry matter, ... 504.

Live weight of animal at beginning of experiment, . . . 18.
Live weight at time of killing, ... 209.
Live weight gained during experiment, ... 190.
Dressed weight at time of killing, ... 168
Loss in weight by dressing, ... 40.5 lbs. or 19.4 pe
Dressed weight gained during experiment, ... 154.

Cost of feed consumed during experiment, —

361.5 lbs. Corn Meal, at $22.50 per ton, ...
208 gals. Skim Milk, at 1.8 cts. per gal., ...

2.64 lbs. of dry matter fed yielded one pound of live weight; ar
lbs. of dry matter yielded one pound of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5 07 cts.

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[B.]

SKIM MILK AND CORN MEAL.

No. 11.

	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day, during Period.
								lb. oz.
.	13.5	109	11 9	24.7	1:2.7	17.0	45.5	0 13
.	51.0	204	44.5	46.3	1:3.1	45.5	89.5	1 3
.	88.0	266	76.6	60.3	1:3.9	89.5	138.0	1 7
.	209.0	252	182.5	27.2	1:5	138.0	191.0	1 8

of feed consumed from Nov. 5, 1884, to March 25, 1885,—

Meal, equal to dry matter, ... 315.5 lbs.
Milk, equal to dry matter, ... 188.5 lbs.

nt of dry matter, ... 504.0 lbs.

nimal at beginning of experiment, . . 17.0 lbs.
ime of killing, ... 191.0 lbs.
ned during experiment, ... 174.0 lbs.
at time of killing, ... 158.5 lbs.
y dressing, ... 32.5 lbs., or 17 per cent.
gained during experiment, ... 144.5 lbs.

onsumed during experiment,—

Meal, at $22.50 per ton, ... $4 07
Milk, at 1.8 cts. per gallon, ... 3 74

$7 81

matter fed yielded one pound of live weight; and 3.48
er yielded one pound of dressed weight.
or production of 1 lb. of dressed pork, 5.4 cents.

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[B.]

SKIM MILK AND CORN MEAL.

No. 12.

PERIODS.	Total Amount of Meal consumed during Period (in pounds).	Total Amount of Milk consumed during Period (in quarts).	Total Amount of Dry Matter in Meal consumed during Period.	Total Amount of Dry Matter in Milk consumed during Period.	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.
1884 and 1885.							
Nov. 5 to Dec. 9, . .	13.5	109	11.9	24.7	1 : 2.7	18.0	48 0
Dec. 9 to Jan. 15, . .	51.0	204	44.5	46.3	1 : 3.1	48.0	97.5
Jan. 15 to Feb. 17, .	88 0	266	76.6	60.3	1 : 3.9	97.5	147.5
Feb. 17 to Mar. 25, .	209.0	252	182.5	57.2	1 : 5.	147.5	216.0

Total amount of feed consumed from Nov. 5, 1884, to March 25, 1

361.5 lbs. Corn Meal, equal to dry matter, ... 315.
831 qts. Skim Milk, equal to dry matter, ... 188

Total amount of dry matter, ... 504.

Live weight of animal at beginning of experiment, . . 18
Live weight at time of killing, ... 216
Live weight gained during experiment, ... 198
Dressed weight at time of killing, ... 173
Loss in weight by dressing, ... 43 lbs., or 19.88 per
Dressed weight gained during experiment, ... 169.

Cost of feed consumed during experiment, —

361.5 lbs. Corn Meal, at $22.50 per ton, ...
208 gals. Skim Milk, at 1.8 cents, ...

2.55 lbs of dry matter fed yielded 1 lb. of live weight; and 2.9
of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.61 cents.

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UMMARY OF RESULTS OF EXPERIMENTS.

Pigs Fed with Buttermilk and Corn Meal.

Corn Meal (in pounds).	Buttermilk (in gallons).	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.	Cost per lb. of Dressed Pork (cents).
399.	346.	188.5	159.0	5.81
399.	346.	201.0	168.0	5.56
399.	346.	180.5	151.0	6.10
338.	287.	146.0	118.0	6.55
338.	287.	179.0	146.0	5.29
338.	287.	183.5	147.5	5 24
2,211.	1,899.	1,078.5	889.5	

Pigs Fed with Skim Milk and Corn Meal.

Corn Meal (in pounds).	Skim Milk (in gallons).	Live Weight gained during Experiment.	Dressed Wt. gained during Experiment.	Cost per lb. of Dressed Pork (cents).
388.5	303.	217.0	178 0	5.24
388.5	303.	201.5	170.0	5.48
388.5	303.	209.0	174.5	5.35
361.5	208.	190.5	154.0	5.07
361.5	208.	174.0	144.5	5.40
361.5	208.	198.0	169 5	4.61
2,250.	1,533.	1,190.0	990.5	

Cost of Feed Consumed during the Experiment.

Corn Meal,	$24 98
Buttermilk,	26 02
	$51 00
Corn Meal,	$25 42
Skim Milk,	27 60
	$53 02

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Cost of Feed per Pound of Dressed Pork.

A.	Buttermilk and Meal,	5.73
B.	Skim Milk and Meal,	5.35

The pound of dressed pork sold at $6\frac{3}{4}$ cents.

The buttermilk contained 8 per cent. of solids; one of it weighed 34.5 ounces, and contained 2.76 ounces matter; one gallon contained 11.04 ounces of solids. skim milk contained 10.22 per cent. of solids; one qu it weighed 35.5 ounces, and contained 3.63 ounces of s one gallon contained 14.52 ounces of dry organic matt

Average of Analyses of Buttermilk from Nov 6, 1884, to Feb. 5,

[From Amherst Creamery.]

Water,	92.00 p
Total solids,	8.00
	100.00 p
Analysis of Solids:	
Fat,	0.20 p
Protein (nitrogenous matter),	2.65
Ash,	0.60
Non-nitrogenous extract matter,	4.55
	8.00 p

Nutritive Ratio, 1 : 1.9.

Average of Analyses of Skim Milk from Nov. 6, 1884, to Feb. 5,

[From the Experiment Station Farm.]

Water,	89.78 p
Total solids,	10.22
	100.00 p
Analysis of Solids:	
Fat,	0.33 p
Protein (nitrogenous matter),	3.53
Ash,	0.80
Non-nitrogenous extract matter,	5.56
	10.22 p

Nutritive Ratio, 1 : 1.8.

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quent analysis represents the average of the of the corn meal fed during the previously-ding experiments with pigs.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
° C., . . .	12.62	252.40	–	–	
. . .	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Dry Matter.					
. . .	1.56	31.20	–	–	
, . . .	2.66	53.20	18.09	34	1 : 8.76
. . .	4 27	85.40	64.90	76	
(Nitrogenous), . . .	11.43	228.60	194.31	85	
s Extract , . . .	80.08	1,601 60	1,505.50	94	
	100.00	2,000.00	1,782.00		

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FIELD EXPERIMENTS.

C. A. GOESSMANN.

I.

FODDER CORN RAISED UPON UNDERDRAINED AND EXHA LANDS, PARTLY FERTILIZED WITH SINGLE ARTICI PLANT FOOD, PARTLY WITHOUT THE USE OF ANY RIAL MATTER.

[See Sketch A.]

The land turned to account for the experiment ex over an area of one and one-tenth acres, which was vided into eleven plats of an equal size, one-tenth acre each. It had served, for several years previous establishment of the Experiment Station in 1882, meadow for the production of hay. During the spr 1883 it was underdrained, and subsequently planted wit (Longfellow variety), for fodder corn, without the any fertilizer. The same course of planting and culti was carried out during 1884, changing from the Long to the Clark variety of corn, for the purpose of exha the soil, as far as practicable, for the successful cultiva corn.

The entire area (A) was separated by tile drain fr surrounding lands; each plat had, through its whole (from west to east), in the centre, a separate tile drai minating on the east end, and communicating here, by of a well, with a lower main drain, to permit, wh desirable, a separate collection of samples of drainage from each individual plat for a subsequent chemical ination. This system of underdraining was to serve, progress of our work, for an inquiry into the retentive q of our soil with reference to various articles of plant fo

As the corn crop raised in 1884 upon these eleven pl unmanured lands had left no doubt about their exha

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far as the farther cultivation of corn was con-
Second Ann. Rep. of Experiment Station, p.
d advisable to begin the inquiry into the chem-
ical condition of the soil, as far as its relation to
n of the corn crop is concerned, as well as into
power to retain, in a higher or lower degree,
es of plant food, i. e., its qualification to pre-
ssage into the drainage water.

ends in view, the following course was decided
as been carried out during the past season

field (A) here under discussion was prepared
a similar manner for the planting of corn, as in
rs.

. . .	Received no manurial substance.
. .	Twenty-five pounds of sodium nitrate (= to 4 lbs. of nitrogen).
. .	Nothing.
. .	Thirty pounds of dried blood (= to nitrogen, 4 lbs.).
. .	Nothing.
. .	Twenty-five pounds of ammonium sulphate (= to 4 lbs. of nitrogen).
. .	Nothing.
. .	Fifty pounds of dissolved bone-black (= 8.5 lbs. available (phosphoric acid).
. .	Nothing.
. .	Twenty-five lbs. of muriate of potash (= to from 12 to 13 lbs. potassium chloride).
. .	48½ pounds potassa-magnesia sulphate (= to 12–13 lbs. potassium oxide).

as planted May 16th, in furrows three feet and
part, over the entire area, with the exception
which was left unseeded, to study the influence
pheric agencies on the soil under cultivation
sistance of growing plants. From six to eight
e and the same lot (Clark variety) were
e place, and at a distance of from twelve to
es from each other along each furrow. The
were thinned out subsequently, wherever ad-
he entire field kept clean from weeds by a

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timely use of the cultivator. Plat No. 6, being le
seeded, was kept clean from any kind of growth b
same means.

The seed corn proved satisfactory. The young co
peared in all parts of the field at the same time, yet
soon to vary in height and color on different plats.
plants on Plat No. 1 were, July 11th, twelve inches hig
of a fair color; only eight inches high and of a pale,
color on Plats Nos. 2, 3, 4 and 5; from eight to
inches high and pale looking on Plats Nos. 7 and 8; wh
Plats Nos. 9 and 10 they were twelve inches high, of
color, and strong and vigorous in general appearance.

On July 24th the plants on Plat No. 1 were fairly
and two and one-half feet tall; on Plat No. 2 only fro
to two feet high; on Nos. 3 and 4 similar to those o
No. 2; on Plat No. 5 somewhat larger and of better
than on Nos. 3 and 4; on Plats No. 7 and 8 uneven
a yellow color; and on Plats No. 9 and 10 alike of
color, forming a striking contrast to those on the other

On August 5th the plants on Plats No. 1, 2, 3, 4
appeared all alike, dwarfed, from two to three feet
with shrivelled leaves, abortive tassels, and but few ea
Plats No. 7 and 8 a similar condition was noticed,
few tassels, but no silk. The plants on Plats No. 9 a
were well tasselled and silked, quite tall and vigorou
second only in appearance to corn of the same varie
well manured fields. On September 3d no material
ence could be noticed between the growth of Plats No.
2, 3, 4, 5, 7 and 8. The plants were withered from
lowish to a brown color, with but a few and small ears
taining watery kernels. The corn on Plats No. 9 a
was still green and of a luxuriant character, the f
beginning to change color, whilst the complete ears
filled with kernels in the milk.

The growth on the entire field was cut September 5t
the product of each plat stacked by itself in the fie
drying; it was housed October 10th.

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	Amount of Dry Corn Fodder Obtained (pounds).	Fertilizer Applied.
.	480 lbs.	Nitrate of soda.
.	310 lbs.	Nothing.
.	350 lbs.	Dried blood.
.	300 lbs.	Nothing.
	360 lbs.	Sulphate of ammonia.
.	280 lbs.	Dissolved bone-black.
.	250 lbs.	Nothing.
.	945 lbs.	Muriate of potash.
.	845 lbs.	Potassa-magnesia sulphate.

hese results with those obtained in the previous
s.), where the produce of the various plats was
a corresponding weight, — 458 lbs. each, —
the application of potash compounds alone,
ash leading (see Plats No. 9 and 10), has had
t on the quantity and the quality of the corn
increasing the last annual yield not less than
per cent. above that of the preceding year

of corn fodder raised on Plat No. 1, which
e of soda, exceeded but slightly (22 lbs.) that
s season; whilst the application of blood, am-
ate and phosphoric acid has not prevented a
alling off. The yield of corn fodder of fertil-
tilized plats was practically the same in most

these facts it seems justifiable to conclude that
the soil in available potassa controlled more
ny other essential article of plant food the final
op. The experiment furnishes a good illustra-
ided exhaustion. Grass and fodder corn act
irection on the mineral soil resources of plant
art of phosphoric acid to four parts of potassa.
nstances necessitate a direct succession of these
s well to remember that fact, and to provide
re by applying to the soil liberally, in particu-
mpounds in some form or other. Muriate of
to deserve recommendation. The observation
ued during the coming season.

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Analyses of an Average Sample of Fodder Corn collected from Unfertilized Plats — Nos. 2, 4 and 8.

Moisture at 100° C.,	78.50 p
Dry Matter,	21.50
	100.00 p
Analysis of Dry Matter:	
Crude Ash,	3.91 p
" Cellulose,	25.74
" Fat,	2.92
" Protein (Nitrogenous Matter),	13.75
Non-nitrogenous Extract Matter,	53.68
	100.00 p

Analyses of Fodder Corn from Underdrained Plats, with refer Nitrogen and Mineral Constituents (Corn and Grain).

[Collected when harvested.]

1. *Mixed Sample from Three Unfertilized Plats — Nos. 2, 4 a*

Analysis of Dry Matter.		Relative Percentag uble Matter in
Nitrogen,	1 96 per cent.	– –
Crude ash,	3.49 "	– –
Potassium oxide,	0.507 "	22.047 per
Sodium oxide,	0.208 "	9.055 "
Magnesium oxide,	0.544 "	23.662 "
Calcium oxide,	0.455 "	19 764 "
Phosphoric acid,	0.526 "	22.953 "
Ferric oxide,	0.058 "	2.519 "
Insoluble and silicious matter,	1.123 "	– –

2. *Sample from Plat Fertilized with Muriate of Potash — N*

[Collected when harvested.]

Analysis of Dry Matter.		Relative Percentag uble Matter in
Nitrogen,	1.77 per cent.	– –
Crude ash,	6.26 "	– –
Potassium oxide,	1.259 "	43.154 per
Sodium oxide,	0.157 "	5.436 "
Magnesium oxide,	0.488 "	16.711 "
Calcium oxide,	0.545 "	18.658 "
Phosphoric acid,	0.397 "	13.625 "
Ferric oxide,	0.071 "	2.416 "
Insoluble and silicious matter,	1.614 "	– –

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rom Plat Fertilized with Dissolved Bone-black — No. 7.

[Collected when harvested.]

Analysis of Dry Matter.		Relative Percentage of Soluble Matter in Ash.
. . . .	1.99 per cent.	– – –
. . . .	4.92 "	– – –
e, ...	.47 "	16 876 per cent.
. . . .	.07 "	2.390 "
ide, . . .	.77 "	27.488 "
. . . .	.78 "	27.760 "
d, ...	.63 "	22.319 "
. . . .	.09 "	3.158 "
ilicious matter,	1.99 "	– – –

rom Plat Fertilized with Sulphate of Ammonia — No. 5.

[Collected when harvested.]

Analysis of Dry Matter.		Relative Percentage of Soluble Matter in Ash.
. . . .	2.01 per cent.	– – –
. . . .	5.08 "	– – –
e, ...	.52 "	19.664 per cent.
. . . .	.06 "	2.276 "
ide, . . .	.81 "	30.792 "
. . . .	.60 "	22.588 "
d, ...	.60 "	22.659 "
. . . .	.05 "	2.024 "
ilicious matter,	1.19 "	– – –

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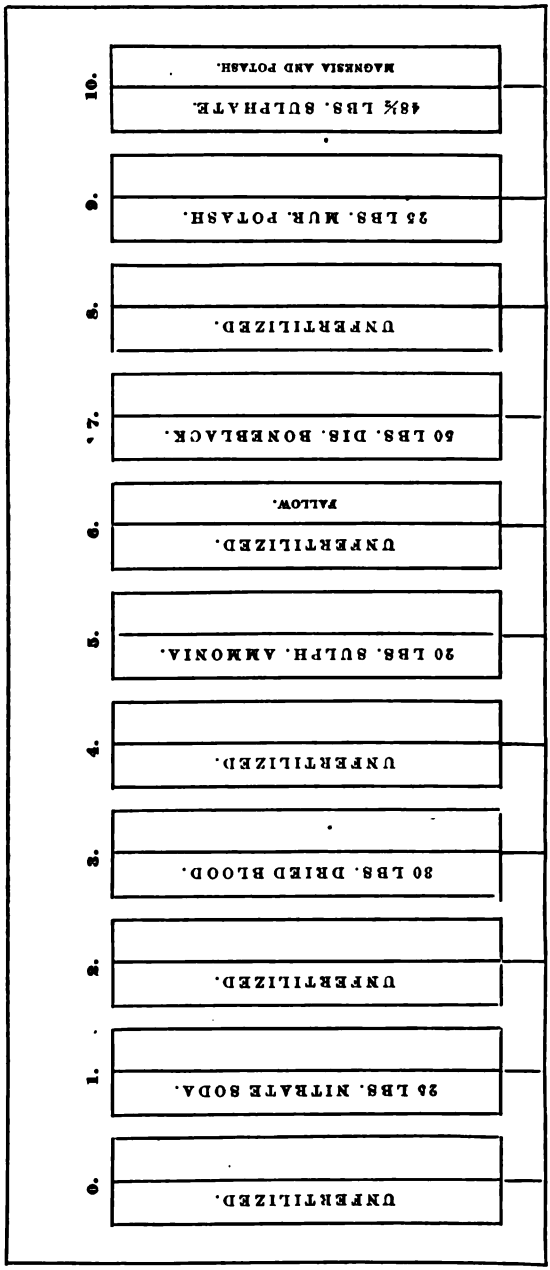
"SKETCH A."



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II.

OF FERTILIZERS ON THE QUANTITY AND QUAL- OF SOME PROMINENT FODDER CROPS.

[See Sketch B.]

r history of the field (B) which has been re- ese experiments, as well as a description of the adopted regarding the latter, was outlined in nnual Report, pages 85 and 86.

field was ploughed and harrowed May 12, and subdivided, in the same manner as in the pre-, into eleven plats of corresponding size, — an acre each. Plats No. 11, 13, 15, 17, 19 eceived, as in the previous year, a mixture of of steamed ground bones and of twenty pounds potash; whilst Plats No. 12, 14, 16, 18 and 20 nanurial matter as fertilizer. The latter had lized for two preceding years. The fertilizer, cast to each alternate plat, as above stated, was wed under before seeding.

n. — The observations concerning the develop- ndian corn, and its general character at various wth, have been continued in this connection se of furnishing a more reliable basis for the e question, — At what period of its growth is it st the crop for either dry corn fodder or corn idering in both cases the quality and quantity cured?

7, 18, 19, 20 and 21 served again, as in pre- for the cultivation of corn. "Hampden Pro- as planted in rows, May 16, in a similar way n connection with the corn experiment upon plats (field A); *i. e.*, in rows three feet and om each other, with from six to eight kernels twelve to fourteen inches apart, to allow a vth and a thorough, clean cultivation. The on the fertilized Plats No. 17, 19 and 21 was rt for ensilage; that obtained from the unfer- No. 18 and 20 was to be sold as dry fodder

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corn; both crops were to be cut at the same time to
pare results.

The seed corn planted proved a failure; but a few p
made in due time their appearance. An examinatio
the ground showed that maggots were feasting on the
nels. The rows were for this reason re-furrowed an
planted with "Clark" corn, — a variety which had
raised upon the same plats during the preceding year.

The young plants appeared on all the plats at abou
same time; they differed, however, already, to a cons
able degree, in size and general appearance, by the 11
July. Those growing on fertilized plats were from
20 inches high, and of a vigorous appearance; whilst
upon unfertilized plats varied in height from 8 to 12 in
and began to look pale. July 24, the former were from
4 feet high, and the latter from 2 to 3 feet. August 5
former tasselled and began to form ears; the latter lo
much inferior, and formed much smaller tassels. Sep
ber 3, the plants upon the unfertilized plats looked with
and had but a few small ears; the remainder of the
with kernels still soft and in part beginning to glaze
every way very satisfactory.

The entire crop upon all plats was cut Sept. 4, 1885.
dry corn fodder secured from the fertilized plats ave
$5\frac{1}{6}$ tons per acre; and that from the unfertilized plats i
connection obtained $3\frac{1}{10}$ tons for the same area.

The subsequent analytical statement shows quite strik
the changes which take place in growing corn. The
terial prepared for the analyses was taken from av
specimens of the entire plant at the time of collection.

Determination of Solids in Fodder Corn collected at different S
of Growth.

	July 22.	July 29.	Aug. 5.	Aug. 13.	Aug. 27.	S
Moisture, . .	88.61	85.76	84.64	82.08	81.15	
Solids, . .	11.39	14.24	15.36	17.92	18.85	
	100.00	100.00	100.00	100.00	100.00	1

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f Dry Matter in the above Samples of Fodder Corn.

	July 22.	July 29.	Aug. 5.	Aug. 13.	Aug. 27.	Sept. 3.
. .	8 54	8.00	5.95	5.69	4.70	4.22
.	26.01	27.29	26.40	24.11	24.30	20.93
. .	3.24	2.65	2.26	2.13	1.81	2.63
Nitrog- atter),	17.19	14.42	11.86	11.23	8.87	9.17
s Ex- . .	45.02	47.64	53.53	56.84	60.32	63.05
	100.00	100.00	100.00	100.00	100.00	100.00

granted that the digestibility of a fodder corn hen the seeds are still soft and just beginning been but little impaired as compared with that out tassels, we find it but good economy to de- g of the fodder corn to the first mentioned vth. One ton of green fodder corn in tassel our case 307.2 pounds of dry vegetable matter; case of the seed just beginning to glaze, 463.8 y vegetable matter are found in one ton, — a 156.6 pounds in favor of the more matured rowth.

et (*Penicillaria spicata.*) — The Plats No. 13 seeded down, May 16, in drills three feet and apart. Plat No. 13 was fertilized previously ounds of steamed ground bones and twenty uriate of potash. Plat No. 14 was, as in the ars, left without the addition of any manurial seed germinated in seven days.

n on the fertilized Plat No. 13 soon took the nd general appearance, and maintained that su- il September 10, when the crop produced on s cut for drying. The plants upon the fertilized aceous and from six to seven feet high. They gn of heads in blossom when cut; whilst those

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grown upon the unfertilized Plat No. 14 were of an
even height, had a somewhat yellowish tint of the foli
and showed, by the frequent appearance of heads in b
som, a premature termination of growth.

The foliaceous character of this plant attracted our at
tion as deserving a trial in our climate. The plant is
scribed, by Mr. H. W. Ravenel, in the annual report of
South Carolina Department of Agriculture for 1885,
native, or naturalized annual, summer-growing grass of
State, needing cultivation for its best success. "The n
ber of names (Egyptian, or Cat Tail, or Candle, or P
Millet) by which this old favorite is known, proves its po
larity. 'A tall, erect, thick-stemmed grass. It grow
the height of six feet or more, and the stalk is termin
by a compact, dense, cylindrical spike resembling a c
mon cat tail, frequently a foot or more in length, and
inch thick, which is studded with the small obovate se
grains, surrounded at the base by an abundance of sh
coarse hairs or bristles.' On rich lands it yields enormou
It repays more than most plants for high manuring
good treatment. The growth is rapid, and *frequent* cutti
may be made in the course of the season, if always d
before the *jointed stalk begins to run upward* to form se
It is not well suited for hay, as the thick, succulent stall
difficult to cure properly."

Our experience confirms these statements. The fertil
Plat No. 13 produced 1,870 lbs. of dried millet, or 18,
lbs. ($9\frac{1}{3}$ tons) per acre; and the unfertilized Plat No.
(for three succeeding years without manure) produced 1,
lbs. of the air-dried crop, or 10,500 lbs. ($5\frac{1}{4}$ tons) for a
responding area.

The subsequent analyses show the composition of the
ducts of both Plats Nos. 13 and 14 in an advanced s
of growth; too far advanced to be relished by our cows
dry fodder, yet well fitted for an acceptable ensila
fodder.

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Analyses of Pearl Millet.

[Collected Sept. 10, 1885.]

	Fertilized Plat No. 13.	Unfertilized Plat No. 14.
C., ...	76.37	77.21
. . .	23.63	22.91
	100.00	100.00

PEARL MILLET.

d Plat of the Experiment Station. Collected Sept. 10, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
C., . . .	7.80	156.00	–	–	1:7.15
. . .	92.20	1,844.00	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . . .	6.68	133.60	–	–	
. . . .	34.31	686.20	–	–	
. . . .	1.47	29.40	12.35	42	
Nitrogenous	7.88	157.60	94.56	60	
Extract	49.66	993.20	645 58	65	
	100.00	2,000.00	752.49	–	

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PEARL MILLET.

[From *Unfertilized* Plat of Experiment Station. Collected Sept. 10, 188

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	8.10	162.00	–	–
Dry Matter,	91.90	1,838.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	7.08	141.60	–	–
" Cellulose,	34.30	686.00	–	–
" Fat,	.89	17.80	7.48	42
" Protein (Nitrogenous Matter),	8.11	162.20	97.32	60
Non-nitrogenous Extract Matter,	49.62	992.40	645.06	65
	100.00	2,000 00	749.86	–

The cultivation of the pearl millet will be continued
ing the coming summer season, to test its economical
as a green fodder at an earlier stage of growth.

Grasses. — The character of the growth which had
ually sprung up in four Plats No. 11, 12, 15 and 1
apart for the production of four single varieties of g
(see Second Report, pp. 84 and 85), — orchard, me
fescus, timothy and red-top, — rendered a change of cu
tion desirable. These grasses had been seeded down b
cast, each separate from the other, in May, 1884, fo
purpose of studying their respective fodder value, et
great variety of grasses, and of other species of plants
gradually made their appearance, which rendered a se
tion in the course of time impracticable. The unfert
Plats No. 12 and 16 were in a worse condition tha
fertilized Plats No. 11 and 15. As drill culture pro
better results, it was decided to turn the sod soon aft
first hay crop was removed, and to reseed subsequen
drills two feet apart.

The reseeding took place Aug. 26, 1885. The y
grasses looked well in the fall. They have been kept

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SKETCH "B."

ORCHARD GRASS. / MEADOW FESCUE.	11.
ORCHARD GRASS. / MEADOW FESCUE.	12.
HUNGARIAN GRASS. / PEARL MILLET.	13.
HUNGARIAN GRASS. / PEARL MILLET.	14.
TIMOTHY. / REDTOP.	15.
TIMOTHY. / REDTOP.	16.
CORN.	17.
CORN.	18.
CORN.	19.
CORN.	20.
CORN.	21.

Corn and Grass Plats. Scale, 4 rods to 1 inch.

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by means of a frequent use of the cultivator and by
weeding.

The same course will be pursued hereafter until a sui
material has been secured for a comparative examinatio
garding their individual merits, as well as the best sta
growth for harvesting, as far as quality and quantity o
crop is concerned.

III.

Fodder Corn for the Silo.

The land used for the raising of ensilage corn exte
over an area of 1.06 acres, which had been used for
years for the production of grass for hay. It was plou
and properly prepared, early in the season, and manured
from ten to twelve loads of barnyard manure, supplem
by three hundred and fifty pounds of ground bones an
hundred pounds of high-grade potash compounds.

This course of manuring was adopted merely for the
pose of turning material on hand to good account. The
was to be laid down again into grass after harvestin
corn.

The latter (Clark variety) was planted May 28, in
three feet and three inches apart. From six to eight ke
were dropped into spots from twelve to fourteen i
apart; and the young plants subsequently thinned o
permit good development of every plant. The seed
proved to be good, and the crop was ultimately in every
a success. The young corn was kept clean from wee
means of a cultivator until July 11, when the whole
was seeded down into grass, using one-half of one bus
timothy and one bushel of red-top. Some parts of the
had to be reseeded after the corn was removed, on ac
of a localized dense growth of the latter, which prev
the grass seed from coming up in a satisfactory degree.

The corn fodder, when cut for the silo, September 3 a
began to acquire a slightly yellowish tint along the ou
of the field, yet was still green and succulent in the in
parts; the kernels were soft, their contents somewhat m
and their outside just beginning to glaze. This conditi

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, as has been shown on previous occasions, l for the production of corn ensilage. The —

	Per Cent.
., ...	70.81
. . . . .	29.19
	100.00

e. — Two silos of a corresponding size, five , inside measure, and eleven feet deep, were eriment. In both instances the corn was cut n one and one-quarter to one and one-half hey were, however, filled in a different way. the west side was filled to a depth of from et, as fast as the cut corn could be supplied wn. As soon as the amount of corn assigned 5 tons) was filled in, the surface was carefully rred paper and tight-fitting boards, and at own with twenty-five barrels of sand. A tering thermometer was safely buried at a two feet in the mass, to record the highest ich the latter would reach during the time of closed.

e east side was, September 4, loosely filled hirds of its height, and the mass merely treading it down. It was left in this con- covering, until September 7, at 8 o'clock A.M. had settled from eighteen to twenty-four r of acetic acid became slightly perceptible, of cornstalk, although sweet to the taste, reaction to the litmus paper.

mperature	at	6	inches	depth,	132°,	144°,	138°	– F.
"	"	12	"	"	147°,	145°,	147°	– F.
"	"	18	"	"	140°,	–	–	– F.
"	"	6	"	"	129°,	134°,	147°,	131° F.
"	"	12	"	"	136°,	145°,	131°,	147° F.
"	"	6	"	"	129°,	141°,	138°,	113° F.
"	"	12	"	"	141°,	145°,	145°	– F.
"	"	24	"	"	136.5°,	–	–	– F.
"	"	30	"	"	114°,	–	–	– F.
"	"	36	"	"	107°,	–	–	– F.

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As the temperature remained practically at a sta
the filling in of more fresh-cut corn was resumed,
silo completely, yet loosely, filled September 8.
imum registering thermometer was buried in the m
depth of two feet from the surface, and light boards
laid upon the top.

Sept. 10, 8 A.M.	Temperature at	6	inches	depth,	122°, 123°,
" 10, 8 A.M.	"	" 12	"	"	129°, 127°
" 10, 4 P.M.	"	" 6	"	"	118°, 130°,
" 10, 4 P.M.	"	" 12	"	"	120°, 127°,

The mass had now settled eighteen inches.

Sept. 11, 8 A.M.	Temperature at	6	inches	depth,	127°, 131°
" 11, 8 A.M.	"	" 12	"	"	127°, 129°
" 12, 8 A.M.	"	" 6	"	"	125°, 131°
" 12, 8 A.M.	"	" 12	"	"	122°, 132°

The mass had settled from twenty-four to thirty
The temperature remained practically the same; t
was covered carefully with tarred paper and tigh
boards, in the same manner as in case of the first s
subsequently pressed down with twenty-five barrels
September 12. This silo contained eight tons of gre
fodder.

The temperature observations above recorded were
different parts of the silo; they show that it is quite
to secure a desirable uniform temperature within t
in all parts of the silo, at the same depth and at t
time.

A description of the quality of the ensilage fro
silos, with a record of highest temperatures attained
cases, after closing the silos, will be published here
the bulletins of the Station, as soon as the silos are
for use.

It is proposed to compare, during the present
season, the feeding effect and economy of a good co
lage with that of a good root crop.

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IV.

Concerning the Adaptation of some Fodder Crops new to our Section of RY.

reports has already been urged the desir-
ucing into our agricultural industry a greater
ler plants, to supplement and increase the
tures and meadows, and of the corn in its
s a fodder article.

terest so generally manifested in later years
of the silo is but a strong expression in
w taken in this matter. Every progressive
es the present condition of our fodder supply,
nomical support of a fair proportion of live
erest of a remunerative farm management, is
hether this result can be obtained in a satis-
by increasing the production of one crop,
ost promising one in our section, is open to
To raise corn for the silo has, no doubt,
es afforded a temporary relief, and thus not
oved a valuable helpmate in compounding
liet for cattle.

in a mixed farm management, merely the
-producing fitness of the soil under cultiva-
be said in favor of the endeavor to increase
ed to the production of corn fodder, and to
oduct in a palatable condition for cattle feed,
; for the Indian corn stands in the front rank
lants, as far as the annual production of vege-
concerned.

nt, however, must be our judgment, when we
rious consequences of a too frequent raising
p upon the same soil, on the future product-
latter; or when we keep in mind the fact that
nor any other agricultural plant, furnishes a
e of fodder in all cases.

ny in farm practice requires that we should
rm crops in such an order of succession that

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the natural resources of the soil and of the air may be t
to account, as far as practicable, to their full extent
the other hand, each single article of fodder needs su
menting with reference to the particular wants of the v
kinds, ages and functions of the animals kept on the
in the interest of the highest remunerative return.

Some fodder crops prosper on one kind of soil,
upon another. To procure the largest amount of va
vegetable matter at the lowest expense is, then, only
sible when perfectly safe crops, as far as climate and so
concerned, are selected. It is the ultimate object of
vious and present statements made under the headi
this chapter, to assist in selecting, for local trials, su
fodder plants of well established reputation in other se
of our country, as well as of Europe. (See Secon
port, pp. 89–100.)

Horse Bean (*Vicia Faba.* L.). — Some of the char
istics of this valuable plant have been described in th
annual report (pages 97–100). The analyses of the ma
plant — straw and beans — were published on that occ
During the past season their fitness for a mixed fodder
barley and oats, has been tested, and also their appli
as a green manure.

The field, .98 of an acre in size, which had been occ
during the past years by a variety of leguminous plant
some roots, was ploughed April 21st, and manured w
mixture of steamed ground bones and muriate of pota
the rate of six hundred pounds of the former and two
dred pounds of the latter per acre. The fertilizer
applied broadcast and incorporated by the harrow.

The field was subsequently subdivided into two
parts, .49 of an acre each in size. One part served fo
production of a mixed crop of horse bean and oats, an
other for that of horse bean and barley. The crops r
ing were to be cut at blooming, and were destined to
as a fodder constituent in future feeding experiments.

Horse Bean and Oats. — Two bushels of oats and tw
four quarts of horse beans were sown broadcast, April
and harrowed under. Both seeds came up quite evenly
began blooming about June 12th, or within from fort
to fifty days from the day of seeding.

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as cut before the oats were fully matured, e yield amounted to 2,800 pounds, or 1.4 ton ing from 15 to 18 per cent. of moisture.

n Oats and Green Horse Bean when cut, July 9, 1885.

	Oats.	Horse Bean.
C., ...	69.45	84.88
. . . . .	30.55	15.12
	100.00	100.00

HORSE BEAN.

in bloom from Plats of the Station, July 9, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of constituents.	Nutritive Ratio.
C., . . .	84 83	1,696.60	–	–	1 : 2.71
. . .	15.17	303.40	–	–	
	100.00	2,000.00	–	–	
ry Matter.					
. . .	5.75	115.00	–	–	
. . .	28.17	563.40	–	–	
. . .	2.31	46.20	30.95	67	
Nitrogenous . . .	16.68	333.60	236.86	71	
Extract . . .	47.09	941.80	565.08	60	
	100.00	2,000.00	832.89	–	

matured horse bean, and of straw and pods, rted in the Second Annual Report, pages 98

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HAY OF OATS.

[From Plats of Station, cut while in milk, July 9, 1885.]

	Per centage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of
Moisture at 100° C., . . .	9.55	191.00	–	–
Dry Matter, ...	90.45	1,809.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash, ...	6.08	121.60	–	–
" Cellulose, ...	34.32	686.40	–	–
" Fat, ...	2.69	53.80	24.75	46
" Protein (Nitrogenous Matter), ...	10.89	217.80	124.15	57
Non-nitrogenous. Extract Matter, ...	46.02	920.40	920.40	100
	100.00	2,000.00	1,069.30	–

Some of the green crop was used in a feeding expe
with milch cows previous to the time of cutting for ha

Horse Bean and Barley. — Forty-nine one hu
of an acre of land, ploughed and manured in con
with the field which served for the production of hors
and oats, was seeded down with one and one-half
of barley and one-half a bushel of horse bean, M
The day of seeding was delayed on account of the late
of the barley. The advanced season hastened the gro
both barley and horse bean. The latter began to bl
but one week after that seeded in connection with th
the barley was fully in head June 20. The crop
when the barley grain was still in the milk, July
yielded, when housed, 2,900 lbs. of dry fodder, or 1.4
containing still from 15 to 18 per cent. of moisture.

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Green Barley and Green Horse Bean when cut, July 9.

	Barley.	Horse Bean.
)° C., ...	57.73	84.88
. . . . .	42.27	15.12
	100.00	100.00

HAY OF BARLEY.

ey was cut July 9, 1885, while the seeds were in the milk.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
)° C., . .	10.25	205.00	–	–	1:9.59
. . .	89.75	1,795.00	–	–	
	100.00	2,000.00	–	–	
Dry Matter.					
. . .	4.95	99.00	–	–	
, . . .	29.12	582.40	–	–	
. . .	2.76	55 20	25.39	46	
(Nitrogenous), . . .	10.26	205.20	116.96	57	
s Extract . . .	52.91	1,058.20	1,058.20	100	
	100.00	2,000.00	1,200.55		

crop was fed green in connection with a feed-
nt with milch cows.

f horse bean, see above.

mixture of fodder plants upon one and the
as proved, in many instances, good economy;
d is in most instances larger than if each crop
sed by itself. The practice of raising some
crops, together with different kinds of legu-
s, — as clover, vetch, beans, peas, etc., — de-
ious consideration of our farmers.

election of mixed crops for fodder can not only
aid, in the earlier part of the summer season, in

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furnishing nutritious green fodder to the dairy wl tures may fail and green corn fodder fit for an ecc consumption cannot yet be had; but, converted at a time into hay, they can also materially increase the valuable winter fodder.

The addition of foliaceous fodder plants to tho scanty leaf development insures, frequently, a succes latter, when an exceptional dryness of the season danger a satisfactory result. A mixture of clover ar may be a success where either clover or grass, alone be a doubtful crop. They frequently tend to impro the general chemical and physical condition of the s grow on, and render it thereby better fitted for a su cultivation of winter grains. Winter and summer gr most frequently cultivated together with varieties of field beans, field peas; buckwheat, also, frequently into the mixture. The early harvesting of most c mixtures leaves ample time for the preparation of for winter crops.

The proportion in which the seeds of the differen ought to be mixed depends somewhat on the cost of tl In case the seeds of leguminous plants are cheap, i visable to let the mixture consist of two-thirds legu plants to one-third of cereals; whilst, in case the legu seeds are costly, one-half of leguminous plants and of cereal plants. The scanty supply of horse be obliged us to depart from the previous recommendat

After both crops had been housed, the field was ploughed, and, after being manured with one-half th tity of fertilizer used for the production of the fir seeded down, broadcast, July 16, with thirty-four po Hungarian grass seed.

The young plants made their appearance July 2 began to head out August 5, and reached the height twenty to twenty-four inches September 3.

The crop was cut for hay September 8; it amou 2,395 lbs., or 2,444 lbs. of hay per acre, as a seco for the season.

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HUNGARIAN GRASS.

(PANICUM GERMANICUM.)

n bloom from the Plats of the Station, Sept. 3, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
., . . .	74.07	1,481.40	–	–	
. . .	25.93	518.60	–	–	
	100.00	2,000.00	–	–	
y Matter.					
. . .	7.15	143.00	–	–	
. . .	24.66	493.20	–	–	1:6.86
. . .	1.01	20.20	8.48	42	
Nitrogenous . . .	9.38	187.60	112.56	60	
Extract . . .	57.80	1,156.00	751.40	65	
	100.00	2,000.00	872.44	–	

and White Lupine for Green Manuring. — A djoining the experimental plats, represented as to be added to the latter to lengthen out s, to give them a more desirable form for the udy of crops. The soil was worn out by a ing of grass for hay; the annual yield of the off to one-half a ton per acre, and the last ed prematurely. No manurial matter could e soil in consideration of the purpose it was er. To let it lay idle until it was best to sow for experimental purposes was thought not

t condition of the soil suggested the idea to h some leguminous plants, reputed for their een manures, and to prepare the land, in this drill culture, for its future work. To accom- the grass land, .64 of an acre in size, was g the first week of May, and the soil subse- ghly broken up by the wheel harrow. One- l was planted May 16, in drills three feet and

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three inches apart, with horse beans; and the oth
white lupine. The seeds used, in both instances, w
tained from our previous experiments with these
they proved very satisfactory. Both plants — hor
and white lupine — are hardy and mature well in our
of the country.

The fields were kept clean from weeds by frequen
the cultivator. The horse bean began to bloom du
first week of July, and had already attained, Jul
height of from twenty-four to thirty inches. The lu
at that time only reached a height of eighteen inc
showed no sign of blossoms.

Both crops looked remarkably well, and had att
height of about three feet July 22, when they were p
under.

A part of the field not needed for the enlargemen
experimental plats was subsequently laid down in
red-top and herdsgrass — August 20; it proved at t
of the season to be one of the best appearing grass
the ground.

Ash Analysis of Horse Bean.

[Collected July 15, 1885, when in bloom.]

Moisture at 100° C.,	
Dry Matter,	

Ash Constituents in Dry Matter.

Potassium oxide,	
Sodium oxide,	
Calcium oxide,	
Magnesium oxide,	
Ferric oxide,	
Phosphoric acid,	
Insoluble matter,	

Analyses of matured horse bean, and of straw an
have been reported in Second Annual Report, pages
99. For analysis of horse bean in bloom, see above

White Lupine (Lupinus albus).

[Collected when in bloom from Experimental Plats of the Station,

Moisture at 100° C.,	
Dry Matter,	

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Analysis of Dry Matter.

	Per cent.
. . . . .	5.03
. . . . .	31.18
. . . . .	2.41
ogenous Matter), ...	18.71
tract Matter, ...	42.67
	100.00

	Per cent.
. . . . .	1.73
. . . . .	.68
. . . . .	3.07
. . . . .	.73
. . . . .	.17
. . . . .	.35
. . . . .	.90

occurrence of a natural dense growth of a wild lupine, on sandy, unimproved, unpro- ong the Connecticut River, suggested the he above described improved variety as a r the reclamation of abandoned farm lands stricts.

ine enjoys a high reputation as a green light, dry, sandy soil. The first season for raising seeds; and the second for test- green manure.

lfa). — Two varieties of this well-known *Iedicago sativa* and *Medicago media* — were the preceding year. Both were seeded t the same time; they came up quite evenly. or sand luzerne soon, however, took the produced fair crops.

sed well through a severe winter. As the oul growth rendered the continuation of the ubtful benefit, it has been decided to repeat ing in drills to secure a better chance for

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LUZERNE.

(ALFALFA; MEDICAGO SATIVA.)

[Collected, when just beginning to bloom, from Plats of the Station, Ju

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of
Moisture at 100° C.,	16.00	320.00	–	
Dry Matter,	84.00	1,680.00	–	
	100.00	2,000.00	–	
Analysis of Dry Matter.				
Crude Ash,	10.45	209.00	–	
" Cellulose,	25.42	508.40	203.36	4
" Fat,	2.50	50.00	19.50	3
" Protein (Nitrogenous Matter),	16.34	326.80	251.64	7
Non-nitrogenous Extract Matter,	45.29	905.80	588.77	6
	100.00	2,000.00	1,063.27	

The green material contained 77 parts of moisture
parts of vegetable matter. The sample for analy
taken from the first growth, when in blossom. T
position of the Luzerne hay compares favorably wit
a first-class hay of red clover in blossom. The pas
has tested severely the adaptation of this valuable
plant to our climate. The plant is noted for its resis
drought, wherever its extensive root system freely d

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SAND LUZERNE.

(MEDICAGO MEDIA.)

om the Plats of the Station; collected in bloom, 1884.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
0° C., . . .	8.80	176.00	–	–	
. . . . .	91.20	1,824.00	–	–	
	100.00	2,000.00	–	–	
f Dry Matter.					
. . . . .	9.57	191.40	–	–	
se, ...	21.27	425.40	170.16	40	1:3.5
. . . . .	2.59	51.80	20.20	39	
(Nitrogenous er), ...	16.26	325.20	250.40	77	
ous Extract	50.31	1,006.20	654.03	65	
	100.00	2,000.00	1,094.79	–	

ety, on the whole, gave better results than the

a (*Dolichos*). — Experiments with two promi-
ies — Clay and Whippoorwill — have been de-
he preceding annual report. The valuable qual-
e plants, as a green manure, as a green fodder,
efficient means, if cultivated in drills, to keep
s, has also been alluded to in that connection.
owing varieties of seeds of peas were secured,
past season, from North Carolina and Mississippi,
May 27th and June 6th, to continue our obser-
arding their respective merits: —

Cow Pea (Whippoorwill variety).
Cow Pea (Clay variety).
Black Stock Pea.
Conch Pea.
Chinese Prolific Pea.
Rice Pea.

up well and sent out runners by August 5th;
em branched out subsequently, profusely, and

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represented, September 21st, a dense green mass from
and a half to three feet high, with runners frequently
five to six feet long. Most of them were, at that perio
full blossom, and some matured subsequently a few pod

The Clay and Whippoorwill seemed, on the whole,
us, the leading varieties; all varieties suffered severely
the first frost, October 8th. They were relished as fo
by cows, in the green as well as the dried state.

Experiments in this direction will be continued. A
ety maturing three weeks earlier has been promised
friend in North Carolina for the coming season.

Three analyses of Cow Peas, raised on another occa
will be found in the Second Annual Report, pages 91–9

Aside from the previously described observations,
interesting facts have been obtained during the past se
with regard to the cultivation of Vetches (*Vicia sati*
Serradella (*Ornithopus sativus*, Brot.), Saintfoin or
parsette (*Onobrychis sativa*), Blue and Yellow Lu
Evergreen Millet (Denver, Colorado), Summer Rape
Winter Rape (*Brassica napus*).

V.

Experiments with Potatoes.

Var.: Beauty of Hebron.

The arrangement of the field, the mode of manuring,
the variety of potatoes raised have been the same as in
preceding season. (See Second Annual Report, pp. 87–
The three plats set aside for the experiment, each one-
of an acre in size, were prepared for the experiment,
planted April 27th. Plat No. 1 received, as fertilizer, th
pounds of muriate of potash and one hundred and th
pounds of steamed fine-ground bones; Plat No. 2 rece
no fertilizer; Plat No. 3 was fertilized with fifty-e
pounds of potassa-magnesia sulphate and one hund
and twenty pounds of fine-ground bones. The rows w
three feet and three inches apart, and the seed pota
dropped from eighteen to twenty-four inches in the ro
One-half of each plat was planted with medium-sized wh
potatoes; one-half with half a potato in the spot.

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g crop was hoed June 9th. The difference in nce of the plats was quite marked, July 24th; o. 1) with muriate of potash had the largest looked darker green than the remainder; that sulphate (No. 3) looked next best. A blight s, which showed itself during the first week of ninated prematurely the experiment; the vines ats died soon after. The crop was harvested , with the following results: —

PLAT No. 1.

o.	Fertilizer Applied.	Yield of Potatoes upon One-Fifth of an Acre, in Pounds.		
		Large.	*Small.*	*Total.*
.	120 lbs. ground bones and 30 lbs. muriate of potash.	705	355	1,060
ato,		695	270	965
		1,400	625	2,025

PLAT No. 2.

		Large.	*Small.*	*Total.*
.	Not Fertilized.	335	350	685
ato,		255	270	525
		590	620	1,210

PLAT No. 3.

		Large.	*Small.*	*Total.*
.	120 lbs. of bone and 58 lbs. potassa-magnesia sulphate.	605	490	1,095
to,		540	580	1,120
		1,145	1,070	2,215

oes from all the plats suffered severely from

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Determination of Solids in Potatoes.

JULY 24.

	From Plat No. 1.	From Plat No. 2.	From No.
Moisture at 100° C., ...	81.44	79.49	79.
Solids, ...	18.56	20.51	20.
	100.00	100.00	100.

AUGUST 5.

Moisture at 100° C., ...	80.96	81.04	79.
Solids, ...	19.04	18.96	20.
	100.00	100.00	100.

AUGUST 27.

Moisture at 100° C., ...	79.85	80.60	80.
Solids, ...	20.15	19.40	19.
	100.00	100.00	100.

The large proportion of small potatoes, unfit for the m ket, which have been obtained in particular from Plats 2 and 3, show not less a premature termination of a hea ful condition of the entire crop, than the low percentag solids in the potatoes harvested. The normal growth of tuber came apparently to a standstill soon after the examination for solids had been made.

A well-matured potato contains on an average twe five per cent. of solid matter. What exact relation "blig and "scab," or both, bear to failure of the crop, is a q tion claiming deservedly our serious attention.

Fodder Analysis of Potatoes,

[From Plat treated with Potassa-Magnesia Sulphate.]

Moisture at 100° C., ...

Solids, ...

1

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Analysis of Dry Matter.

. . . . .	4.63
ılose, ...	1.98
(Ether Extract), ...	.83
ein (Nitrogenous Matter), ...	13.56
enous Extract Matter, ...	79.00
	100.00

results confirm the above expressed view, — the were not matured.

VI.

Experiments with Root Crops.

portance quite generally conceded to the introduc- liberal cultivation of root crops in a mixed farm ent, wherever a deep soil and the general character mate favors their normal development, rests mainly ollowing consideration: they furnish, if properly and cultivated, an exceptionally large quantity of vegetable matter fit for fodder for various kinds of stock, competing in this direction favorably with green fodder crops; and they pay well, on account returns for the necessary care bestowed upon them ough deep cultivation to meet success.

ysical conditions of the soil, however favorable they been for the production of crops of a similar char- l suffer, if year after year the same system of culti- carried out. Diversity in the mechanical treatment l, and change of season for such treatment, cannot but affect advantageously its mechanical condition degree of its chemical disintegration, promoting s fitness for retaining inherent plant food, as well ver of turning to account atmospheric resources of wth. The roots of the same plants abstract their r after year, from the same layer of soil, while a f crops with reference to a different root system possible to make all parts of the agricultural soil e in a desirable succession towards an economical n of the crops to be raised. Deep-rooting plants, prominent root crops, for this reason, deserve a

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particular consideration in the planning of a rational systen of rotation of crops.

The fodder supplied by roots, although somewhat peculia in its composition when compared with that obtained fron many of our prominent fodder plants, where the upper par of the plants furnishes the main bulk, may, nevertheless serve as a very valuable constituent in the diet of variou kinds of farm live stock, when properly supplemented by oi cakes, grain, bran, hay, etc.

The various kinds of roots usually raised on farms fo feeding purposes, differ essentially in regard to the amoun of dry vegetable matter they contain. Turnips contain fron 7 to 8 per cent.; ordinary mangolds from 11 to 12 per cent. improved varieties of beet roots, like Lane's, from 15 t 16 per cent.; good carrots from 15 to 16 per cent.; a goo sugar beet from 18 to 20 per cent. of solids; or, in othe words, one ton of an improved variety of ordinary suga beets is equal to from two to two and one-half tons of ordi nary turnips, as far as the amount of dry vegetable matte is concerned.

Modes of cultivation and of manuring exert a decided in fluence, in this direction, on the composition of the roots Large roots of the same variety contain quite frequently les *solid* matter than the smaller ones. Close cultivation in th rows, in connection with the use of well-decayed manuria matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kin of root is concerned, is otherwise due, in the majority o cases, to a more or less perfect maturity. A liberal manurin with potash and nitrogen, in connection with a scanty suppl of phosphoric acid, is frequently the cause of immature roots at the ordinary harvest time.

To raise roots the second year, after a liberal application o coarse barnyard manure, or the turning over of grass lands, with the assistance of some commercial phosphatic fertilize in the interest of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two

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ts of roots control, more than any other one, their
n solids.

ots which served for our analyses were raised under
nditions, upon a loamy soil, in a fair state of culti-
r the purpose of comparing their composition.

ount of nitrogenous matter stated in the analyses
y case, obtained by multiplying the nitrogen found
ed vegetable matter by 6.25. This course has been
o enable a comparison with analyses of roots made
s years; for this reason no nutritive ratio has been
Root crops are known to contain, on an average,
o 45 per cent. of their nitrogen in other forms than
bstances.

Examination of Sugar Beets.

VILMORIN.

	Weight of Root below Leaf Marks.	Specific Gravity of Juice.	Density: Brix Saccharometer.	Temperature.	Sugar in Juice as indicated by Polariscope.	Moisture at 100° C.	Dry Matter.
.	0 lb. 13¾ oz.	1.050	12°	24° C.	8.19%	85.35	14.65
.	1 lb. 3¾ oz	1.060	15°	21.5° C.	12.04%	84.25	15.75
.	0 lb. 10 oz.	1.060	15°	21.° C.	12.41%	83.55	16.45
.	0 lb. 15¼ oz.	Not	taken.	–	13.30%	80.47	19.53
.	0 lb. 12½ oz.	1.060	14.7°	19° C.	12.40%	84.11	15.89

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Fodder Analyses of Vilmorin Sugar Beets.

	No. 2.	No. 3.	No. 4.	No.
Moisture at 100° C.,	84.25	83.55	80.47	85
Dry Matter,	15.75	16.45	19.53	14
	100.00	100.00	100.00	100
Analysis of Dry Matter.				
Crude Ash,	4.65	4.53	3.85	4
" Cellulose,	6.98	6.75	6.45	5
" Fat,	.64	.68	.58	
" Protein (Nitrogenous Matter),	12.98	10.14	16.13	1
Non-nitrogenous Extract Matter,	74.75	77.90	72.79	7
	100.00	100.00	100.00	10

The low percentage of sugar noticed in some of the va ties is evidently more due to an unfavorable condition of soil than the seeds.

LANE'S IMPROVED SUGAR BEET.

Weight of Root below Leaf Marks,	1 lb. 9
Specific Gravity of Juice,	1.060.
Density: Brix Saccharometer,	15.5°
Temperature,	26° C.
Sugar in Juice as indicated by Polariscope,	11.97%
Moisture at 100° C.,	83.57%
Dry Matter,	16.43

Fodder Analysis of Lane's Improved Sugar Beet.

Moisture at 100° C.,	83.57 per
Dry Matter,	16.43
	100.00
Analysis of Dry Matter.	
Crude Ash,	3.57 per
" Cellulose,	5.27
" Fat,	.83
" Protein (Nitrogenous Matter),	17.44
Non-nitrogenous Extract Matter,	72 89
	100.00

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Yellow Globe Mangold.

Root below Leaf Marks,	1 lb. 1 oz.	
vity of Juice,	1.035	
rix Saccharometer,	9.9°	
re,	25° C.	
ice as indicated by Polariscope,	6.47	per cent.
100° C.,	88.27	"
,	11.73	"

Fodder Analysis of Yellow Globe Mangold.

100° C.,	88.27	per cent.
,	11.73	"
	100.00	"

Analysis of Dry Matter.

	7.83	per cent
lose,	7.08	"
	.73	"
in (Nitrogenous Matter),	12.84	"
enous Extract Matter,	71.52	"
	100.00	"

Southern Prize Turnips.

ed sent on by Department of Agriculture, Washington, D. C.]

Root below Leaf Marks,	0 lb	11¾ oz.
rose), Fehling's test,	4.42	per cent.
rose) after inversion,	4.43	"
100° C.,	91.77	"
,	8.23	"

ots emitted a strong odor similar to that of horse The fresh root contained sulphur equal to .07 per ulphuric acid.

Fodder Analysis of Southern Prize Turnip.

100° C.,	91.77	per cent.
,	8.23	"
	100.00	"

Analysis of Dry Matter.

	7.85	per cent.
lose,	10.12	"
	1.74	"
in (Nitrogenous Matter),	9.67	"
enous Extract Matter,	70.62	"
	100.00	"

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Fodder Analysis of Carrots. (*Danvers.*)

[From Experiment Station Farm, Oct. 21, 1885.]

Moisture at 100° C.,	87.48 pe
Dry Matter,	12.52
	100.00

Analysis of Dry Matter.

Crude Ash,	4.92 pe
" Cellulose,	7.55
" Fat,	3 94
" Protein (Nitrogenous Matter),	9.63
Non-nitrogenous Extract Matter,	73.96
	100.00

Large Carrot.

[From the same Field.]

Moisture at 100° C.,	88.25 per
Dry Matter,	11.75 "
	100.00 "

Small Carrot.

[From the same Field.]

Moisture at 100° C.,	86.72 per
Dry Matter,	13.28 "
	100.00 "

VII.

Miscellaneous Field Observations.

HAY

[From Station Fields, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a Ton of 2,000.	Pounds digestible in a ton of 2,000 lbs.	Per Cent. of Digestibility of Constituents.	
Moisture at 100° C.,	8.30	166.00	–	–	
Dry Matter,	91.70	1,834.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.12	122.40	–	–	
" Cellulose,	30.19	603.80	350.20	58	1:9.5
" Fat,	2.55	51.00	23.46	46	
" Protein (Nitrogenous Matter,)	9.75	195.00	111.15	57	
Non-nitrogenous Extract Matter,	51.39	1,027.80	647.51	63	
	100.00	2,000.00	1,132.32	–	

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"TOPOVER CORN."

[From Fields of Experiment Station, 1885.]

ontained eight rows of kernels. Its average
inches, and its average weight 6.8 ounces. It
83 per cent. of kernels, and 17 per cent. of cob.
weight of one kernel was .52 gram.
ed parts contained: —

	Corn Stover.	Corn (without cob).
0° C., ...	25.00	11.55
. . . . .	75.00	88.45
	100.00	100.00
ysis of Dry Matter.		
. . . . .	6.12	1.47
e, ...	36.10	1.96
. . . . .	2.49	6.61
(Nitrogenous Matter), .	6 47	14.01
s Extract Matter, . .	48.82	75.95
	100.00	100.00

SORREL.

(RUMEX ACETOSELLA.)

for the examination were collected during the
ne, when in blossom. The fresh plant con-
hundred parts: —

	Per cent.
. . . . .	87.07
, ...	11.93
nstituents, ...	1.11

some earthy matter, 0.158).

plant contains no free volatile acid, — as acetic
he strong acid reaction and taste of the juice of

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the plant is largely, if not exclusively, due to the pr
of acid combinations of oxalic acid with the alkalies, p
and soda.

The soluble portion of the ash constituents contai
subsequent substances in the following relative p
tions: —

	Per
Potassium oxide,	1
Sodium oxide,	1
Calcium oxide,	4
Magnesium oxide,	
Ferric oxide,	
Phosphoric acid,	1
	10

The sudden appearance of this well-known plant
lands which, during the preceding season, had been fr
the objectionable weed, suggested the previously de
examination into its chemical composition. A more
matic inquiry into the chemical character and the ha
many of our weeds cannot fail to give us, here and
useful information regarding an intelligent course to
their chances of a luxuriant growth.

Good agricultural authorities in Europe state th
variety of sorrel does not grow upon a calcareous s
thrives upon a sandy soil of a medium state of fe
They recommend a liberal application of lime or mar
effective remedy to check its growth. Judging fr
predominance of lime in the mineral constituents of t
rel, as shown by the above analysis, it seems that the
beneficial action of lime and marl, if true, has to be a
to their modifying influence on the physical and ch
condition of the soil, and not to a deficiency of lim
special plant food.

The material serving for our analysis grew upon
sandy soil.

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UITS AND GARDEN CROPS.

---

he analyses of fruits published below were ob-
onnection with an investigation inaugurated in
quire into the relation of the more prominent
stituents of fruit-bearing plants, to the healthful
the whole plants and the quality of their fruits,
ose of demonstrating the necessity of a rational,
ficient, system of fertilization on the garden and

of communications, of more or less general in-
rding grapes, peaches, currants, apples, etc., are
previous publications of the Massachusetts Agri-
ege, the Report of the Secretary of State Board
re, and of the Director of State Experiment Sta-

is to be continued, with a fair prospect of im-
rtunities in consequence of more favorable finan-
n of the Station.

rial for the analyses of Concord grape, cherry
ite currants, blackberries, raspberries, and Lom-
was obtained from one and the same plat of the
l field, in a moderately good state of cultivation,
eral years without the application of any special
nures. The blueberries were collected in the
Amherst, from a soil largely of granitic origin.
l for the examination of apples — juice and
me from outside sources, as specified in each case.

Concord Grape.

[From Experimental Plats on College Grounds.]

tive Percentage of Essential Ash Constituents.

	Per cent.
oxide,	62.293
xide,	15.495
n oxide,	1.757
de,	1.962
c acid,	18.491
	99.998

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Cherry Currants.

[From Experimental Plats on College Grounds.]

	Per c
Moisture at 100° C.,	87.70
Dry Matter,	12.30
Ash,	.46
Specific Gravity of Juice at 27° C.,	1.035
Sugar (Glucose) in Juice,	–
Acid (Tartaric) in Juice,	–

White Currants (*White Grape*).

[From Experimental Plats on College Grounds.]

Moisture at 100° C.,	84.82 p
Dry Matter,	15.18
Ash,	.59

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	53.81 p
Calcium oxide,	17.46
Magnesium oxide,	4.72
Ferric oxide,	1.47
Phosphoric acid,	22.54
	100.00

Raspberries (*Black Caps*).

[From Experimental Plats on College Grounds.]

Crude Ash,	.33 to .44 p

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	50.000 p
Calcium oxide,	19.441
Magnesium oxide,	9.599
Ferric oxide,	.486
Total phosphoric acid,	20.474
	100.000

Lombard Plum.

[From Experimental Plats on College Grounds.]

Crude Ash,	.29 to .35 p

Relative Percentage of Essential Ash Constituents.

Potassium oxide,	76.589 p
Calcium oxide,	13.261
Magnesium oxide,	2.165
Ferric oxide,	.541
Total phosphoric acid,	7.443
	99.999

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BLACKBERRIES.

[From Experimental Plats on College Grounds.]

. . . . .	.35 to .40 per cent.

ative Percentage of Essential Ash Constituents.

le, ...	51.424	per cent.
, ...	17.222	"
ide, ...	5.300	"
. . . . .	1.421	"
d, ...	24.129	"
	99.999	

BLUEBERRIES.

(*Matured.*)

[Collected July 15, 1885, near Amherst, Mass.]

)° C., ...	82.69	per cent.
. . . . .	17.31	"
ry Matter), ...	.14	"
minoids, 0.875 per cent.)		
. . . . .	Mucilagenous.	
(Tartaric), ...	1.27	per cent.
Glucose, ...	9.34	"
Cane sugar, ...	.46	"
Dry Matter), ...	.16	"

parts of crude ash in dry matter contained 2.04 parts of rthy material.

ative Percentage of Essential Ash Constituents.

le, ...	31 362	per cent.
. . . . .	28.021	"
ide, ...	9.254	"
. . . . .	2.313	"
d, ...	29.049	"
	99.999	

OBSERVATIONS ON APPLES.

JUICE AND POMACE.

Material sent on from Cider Mills.

[From Mixture of Apples.]

OCTOBER 6, 1885.

Juice.

, ...	1.045	
. . . . .	20° C.	
. . . . .	7.58	per cent.
. . . . .	1.00	"

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Pomace.

Moisture,	
Dry Matter,	

OCTOBER 30.

Juice of Sweet Apples.

Specific Gravity,	1.06
Temperature,	13° C
Total Sugar,	11.74
Acid (Malic),	.20

Pomace (Sweet Apples).

Moisture,	75.17
Dry Matter,	24.83
	100.00
Acid (Malic) in original Pomace,	.18

OCTOBER 30.

Juice of Baldwin Apples.

Specific Gravity,	1.055
Temperature,	15° C
Total Sugar,	11.16
Acid (Malic),	.92

Pomace (Baldwin Apples).

Moisture,	82.78
Dry Matter,	17.22
	100.00
Acid (Malic) in original Pomace,	.78

POMACE.

[Colleeted at Mill in Amherst, Mass.]

Moisture,	85.54
Dry Matter,	14.46
	100.00
Acid (Malic) in original Pomace,	.31

Some of this material has been ensilaged, and will be
again, at the proper time, later in the season.

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2. *Rhode Island Greening.*

[All Obtained from the same tree, at Amherst.]

OCTOBER 6, 1885.

Juice.

ty,	1.045
	17.5° C.
	6.56 per cent.
	1.25 "

Pomace.

	69.49
	30.51
	100.00

OCTOBER 28.

Juice.

ty,	1.05
	23.5° C.
	9.44 per cent.
	1.01 "

Pomace.

	78.95
	21.05
	100.00

DECEMBER 2.

Juice.

ity,	1.05
	22° C.
	11.58 per cent.
	.86 "

Pomace.

	78.22
	21.78
	100.00

in original Pomace, .69 per cent

DECEMBER 12.

f Juice pressed out by hand pressure,

ting,	50.43 per cent.
ed Moisture,	83.67 "
Dry Matter,	16.33 "
	100.00

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The juice for the above analyses of Rhode Island (
ings (2) was obtained by means of a hand press.

Apple Juice. — The above stated analyses of the ju
in particular those under the heading (2) Rhode
Greening — were made to show the influence of the s
maturity of the apples turned to account on the comp
of the juice, and consequently on that of the articles
factured from it, — cider and vinegar.

The apples in the above stated case were all take
the tree on the same day, Oct. 6, 1885, and part o
wrapped in paper and put into close drawers in a cool
to be kept for later tests. These analytical results co
with those obtained on a previous occasion.

BALDWIN APPLE.

1877.	Amount of Dry Matter left at 100° to 110° C.	Amount of Moisture left at 100° to 110° C.	Specific Gravity of Juice at 12° to 15° C.	Percent Sugar
Sept. 1, . .	20.14	79.86	1.055	3
Oct. 9, . .	19.66	80.34	1.065	6
Nov 27, . .	–	–	1.075	10

These three samples were taken from the tree on th
stated, and tested without delay.

RHODE ISLAND GREENING.

1877.	Amount of Dry Matter left at 100° to 110° C.	Amount of Moisture left at 100° to 110° C.	Specific Gravity of Juice at 12° to 15° C.	Percent Sugar
Sept. 1, . .	20.27	79 73	1.055	3
Oct. 9, . .	19.68	80.32	1.066	7
Nov. 27, . .	20.25	79.75	1.080	11

The first two samples were tested directly after they
taken from the tree. The third, which resembles cl

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when taken from the tree, October 9th, was
a paper and kept in a close box; it was tested
27th, or about seven weeks after being taken
e. A glance at the above results reveals the fact,
t the Greening taken from the tree suffered simi-
in its composition as the Baldwin left on the tree.
ening of the grape it has been noticed that there
the per cent. of sugar after its removal from
cept by the evaporation of moisture; while in
very marked increase takes place. This would
icate that the starch, which is always present in
was gradually converted into sugar. (See Ab-
vestigation, Report of Secretary of Massachusetts
of Agriculture for 1879-80, p. 365.)
er the apples are advanced towards maturity,
gar is found in the juice, the more alcohol can
subsequently by fermentation, and ultimately
cetic acid will be obtained in an equally well-
negar factory. The attainable quantity of alco-
cider, and of acetic acid in the cider vinegar,
direct relation to the percentage of sugar in the

ariety has its own time for maturing fully, inde-
eason, much advantage may be gained by assort-
es before they are sent to the mill, with reference
ition. Neither half-ripe apples nor much over-
les are best for the mill, to secure the most val-
hey are able to furnish.
mace. — The samples of apple pomace described
reference to their relative fodder value, were ob-
nnection with the production of some of the pre-
orted juice of apples. The fodder analyses of
es are accompanied by fodder analyses of whole
ome instances of the same varieties from which
ad been produced, either at our own laboratory
f a hand press, or by means of an ordinary cider
icinity of Amherst.

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Fodder Analyses of Apple Pomace.

ANALYSES OF DRY MATTER.	R. I. GREENING.	BALD
	Amherst, Oct. 6, 1885.	Pre Oct. 6
Crude Ash,	1.09	1
" Cellulose,	16.58	13
" Fat,	3.19	4
" Protein (Nitrogenous Matter),	6.94	7
Non-nitrogenous Extract Matter,	70.20	72
	100.00	100

Fodder Analyses of Whole Apple.

ANALYSES OF DRY MATTER.	R. I. GREENING.	SWEE
	Amherst, Oct. 28, 1885.	Pr Oct.
Crude Ash,	2.13	
" Cellulose,	7.05	
" Fat,	2.81	
" Protein (Nitrogenous Matter),	4.57	
Non-nitrogenous Extract Matter,	83.44	8
	100.00	10

The value of apple pomace for feeding purposes de
largely, if otherwise in a good condition, on the amo
dry matter it contains. In our case the latter varied,
fresh from the mill, from 15 to 20 per cent., makin
per cent. the average result.

The same circumstance applies to the determination
relative fodder value of the whole apple. The amo
dry matter found in the whole apples did not, in ou
differ essentially from that found in the various pomac

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ace is richer in nitrogenous matter than the apple
it has been produced. The money value of its
stituents is usually assumed to be, pound for
-third higher than that of the whole apple which
its production.

natured apple yields, in a good mill, from 55 to
t. of juice and from 40 to 45 per cent. of pomace.
authorities (E. Wolff) consider the money value
lder constituents contained in good varieties of
pears somewhat higher than that contained in an
ht of turnips; and those of the apple pomace
ose of sugar beets.

and apple pomace ought to be fed in moderate
similar to those adopted in case of root crops, to
r full benefit as an efficient ingredient of the daily
rious kinds of farm live stock. Being deficient,
ely speaking, in nitrogenous and certain saline
s, they ought to be liberally supplemented for
with wheat shorts, bran, oil cakes, clover, good

een recommended to sprinkle, in the earlier part
son, over the crushed, half-matured apple mass,
rized chalk, to counteract the action of an excess
anic acids on the digestive organs.

f the pomace has been ensilaged to study the
the silo.

rcity of reliable analyses of our prominent fruit
well as of parasitic vegetation, which at times
on them, may serve as an excuse for closing this
th some analyses of C. Erdmann, taken from his
, "The Inorganic Constituents of Plants": Göt-
55.

Analysis of Apple-tree (Wood).

[Collected in the beginning of June.]

	Per cent.
ide,	3.461
e,	1.836
le,	57.070
xide,	2.827
iron,	1.400

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Phosphoric acid,	
Sulphuric acid,	
Silicic acid,	
Chlorine,	
Carbonic acid,	
Loss (carbon, etc.),	
	10

Analyses of Mistletoe (Viscum album).

[Taken, in the beginning of June, from an apple-tree.]

The specimens which served for the following anal were collected at the same time when the wood of the ap tree upon which they had grown was secured for the pre ing analysis.

Moisture in stems,	56.68 per
Moisture in leaves,	62.52
Ash constituents in stems,	1.90
Ash constituents in leaves,	3.85

One hundred parts of the ash constituents contained:

	Leaves.	Ste
Potassium oxide,	19.736	20.
Sodium oxide,	4.327	4.
Calcium oxide,	22.600	22.
Magnesium oxide,	9.335	9.
Phosphate of iron,	1.580	1.
Phosphoric acid,	16.370	16.
Sulphuric acid,	1 250	1.
Silicic acid,	2.053	2.
Chlorine,	.864	.
Carbonic acid,	16.800	15.
Loss (carbon, etc.),	6.786	6.
	100.000	100.

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rison of the ash constituents of the leaves and of f the mistletoe shows but a very slight difference; e of both, compared with those of the apple wood rown on, show a marked difference in potassa, horic acid and magnesia. The ash of the para- s six times more potassa, five times more phos- , and four times more magnesia than that of the e apple-tree; the latter, on the other hand, con- nd one-half times more lime than the former.

s influence of the growth of the parasite on the dition of the tree can scarcely be doubted.

Cranberry.

imens of the cranberry which served for this test hed by parties engaged in their growth and de- now the relative proportion of the essential ele- ant food, for the purpose of determining what to e soil.

ysis is republished in consequence of frequent in-

wing tables give the analyses of the fruit two harvesting. One hundred air-dry weight parts —

	1877.	1878.
at 100° to 110° C.,	89.290	89.890
	10.710	10.110
nts in Dry Matter,	–	.179
Dry Matter,	–	.160
ity of Juice at 15° C.,	1.025	1.025
in Juice,	1.350	1.700
Juice,	2.250	2.430

sugar was found; the acid, probably, was of two tric acid or the acid of the lemon, and malic acid the apple.

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The dried ash of the cranberries collected in 187
tained : —

Potassium oxide,	47.96 p
Sodium oxide,	6.58
Calcium oxide,	18.58
Magnesium oxide,	6.78
Ferric oxide,	.66
Phosphoric acid,	14.27
Silicic acid and trace of sand,	5.22

Rhubarb.

	Stems and Leaves. Fresh.	Root Fres
Moisture at 100° C.,	91.67 per cent.	74.35 p
Dry Matter,	8.33 "	25.65
Nitrogen (in Dry Matter),	.13 "	.55
Crude Ash (in Dry Matter),	1.72 "	2.28
Insoluble Matter in Ash,	.22 "	.25
Potassium oxide,	.36 "	.53
Sodium oxide,	.03 "	Not deter
Calcium oxide,	.34 "	.50 p
Magnesium oxide,	.13 "	.16
Phosphoric acid,	.02 "	.06
Ferric oxide,	.003 "	.02

Relative proportion of the essential ash constituents
ble in acids : —

Potassium oxide,	41.37 per cent.	37.92 p
Sodium oxide,	3.39 "	8.84
Calcium oxide,	38.62 "	35.95
Magnesium oxide,	14.50 "	11.40
Phosphoric acid,	1.80 "	4.32
Ferric oxide,	.32 "	1.57

The analysis has been carried out at the request of g
farmers in the eastern part of the State. The samp
collected from the fields of the college at the time wh
plant was blooming. The results may give some mor
nite basis for an advantageous mode of manuring.

Horse Radish.

(COCHLEARIA ARMOVACIA L.; MUSTARD, FAMILY, — CRUCIFI

The examination of this well-known garden plant wa
ried on at the request of a farmer in Franklin County,

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the preparation of horse radish, with vinegar, for
The roots had evidently lost some of their orig-
re by storing, at the time of their examination.
dred parts of the fresh roots contained: —

00° C.,	76.68	per cent.
	23.32	"
Dry Matter,	.36	"
ry Matter,	.06	"
n Dry Matter,	1.87	"

le ash — 1.87 — consisted of 0.71 parts of insolu-
s matter (including, most likely, some soil), and
ts of soluble mineral constituents of plant food.
proportion of essential ash constituents, soluble
lphur and chlorine excluded: —

xide,	8.24	per cent.
	2.13	"
le,	13.47	"
e,	10.29	"
ide,	62.06	"
cid,	3.81	"
	100.00	

s contain, besides a notable amount of nitrogenous
s, a series of valuable non-nitrogenous substances,
sugar, gum, and organic acids, — a circumstance
ot fail to impart to them a considerable nutritive
l, if not superior, to several of our most valuable
. Their peculiarity consists, mainly, in the
f some sulphur-containing organic constituents
etc.), which cause, in the fresh and crushed roots,
tion of a sulphur-containing, volatile compound.
resembles, in odor and taste, the volatile mustard
nallyl). Some investigators assume their iden-
amount of this product, according to the state-
good observers, depends largely, either on the
aracter of the soil, or on the presence of some
nstituent in the latter. It would be not without
study the effect of gypsum, or of sulphate of pot-
pecial fertilizer, on the character of the roots
eir presence.

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ANALYSES OF FODDER AND FOO

HAMPDEN PROLIFIC CORN.

[Sent on for examination from Springfield, Mass.]

The ears contained from eighteen to twenty rows o
nels, were of a whitish color, and had an average len
from 9¾ to 10 inches. They consisted in weight of
86.5 to 88.2 per cent. of kernels, and from 21.8 to 23
cent. of cobs. The average weight of the ears sent on,
from 473.4 to 491.4 grames (about 1 lb.); that of a
kernel, from .39 to .43 grames. The moisture amo
to from 8.02 to 11.43 per cent.

No. 1 was raised upon a sandy loam, in good conditi

No. 2 was raised upon a heavy soil, in good cond
according to statements made.

	No. 1.	N
Moisture of kernels,	11.43	
Dry Matter,	88.57	9
	100.00	10
Analysis of Dry Matter.		
Crude Ash,	1.72	
" Cellulose,	2.17	
" Fat,	4.52	
" Protein (Nitrogenous Matter),	11.36	1
Non-nitrogenous Extract Matter,	80.23	7
	100.00	10

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sis of this variety of corn furnishes an additional
of the influence of fitness and condition of soil on
tion of one and the same kind of crop, under
atical conditions. The corn No. 2 contains nearly
20 per cent., more fat and nitrogenous com-
e most costly constituents — than sample No. 1.
on of the above stated analytical results, with
of prominent varieties of corn raised within the
s that, as far as composition is concerned, the
rolific Corn may be counted of equal value with
andard articles. For details I refer to an article
ve Value of Several Prominent Varieties of East-
n and Southern Corn," published in the annual
e secretary of the Massachusetts State Board of
for 1879, pages 221–250.

e our farm crops well pays, as a rule, not less in
e improvement in quality than in the increase of

I. BLUE JOINT GRASS HAY.

(CALAMAGROSTIS CANADENSIS.)

s along the Ipswich River; for the Essex County Agricultural Society.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
° C., . .	5.90	118.00	–	–	
. . .	94.10	1,882.00	–	–	
	100.00	2,000.00	–	–	
Dry Matter.					
. . .	6.20	124.00	–	–	
e, . . .	28.91	578.20	335.36	58	1 : 13.08
. . .	2.54	50.80	23.37	46	
(Nitrogenous r), . . .	7.29	145.80	83.11	57	
s Extract Mat- . . .	55.06	1,101.20	693.76	63	
	100.00	2,000 00	1,135.60	–	

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The grass had been cut in the first week in August. hay sent on consisted in the main of blue joint gra contained, besides, a variety of other plants found in localities, as *juncus*, *cyperus*, etc. Its composition is to that of several samples of hay obtained from t marsh meadows, sent on by the Rowley Farmers' Club. First Annual Report, 1883, pp. 74 and 75.)

II. BUNKER MEADOW HAY.

[Sent on by the Secretary of the Essex County Agricultural Society

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	11.35	227.00	–	–
Dry Matter,	88.65	1,773.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	6.40	128.00	–	–
" Cellulose,	30.71	614.20	208.83	34
" Fat,	2.29	45.80	34.81	76
" Protein (Nitrogenous Matter),	7.66	153.20	130.22	85
Non-nitrogenous Extract Matter,	52.94	1,058.80	995.27	94
	100.00	2,000.00	1,369.13	–

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III. HIGH MEADOW HAY.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C., . . .	10.60	212.00	–	–	1 : 8.12
. . . . .	89.40	1,788.00	–	–	
	100.00	2,000.00	–	–	
of Dry Matter.					
. . . . .	7.58	151.60	–	–	
ose, ...	27.23	544.60	185.16	34	
. . . . .	2.77	55.40	42.10	76	
in (Nitrogenous tter), ...	9.33	186.60	158.61	85	
nous Extract	53.09	1,061.80	998.09	94	
	100.00	2,000.00	1,383.96	–	

ve described samples of hay, I., II. and III., have ined by the direction of the Secretary of the Essex gricultural Society, for farmers in Topsfield, Mass. ad been obtained from meadows in the vicinity of h River. No. III. is the most nutritious material, I. has a larger amount of digestible matter than

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CORN MEAL.

[93.28 per cent. passed through mesh 144 to square inch. Bought of J. L.
South Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	11.95	239.00	–	–
Dry Matter,	88.05	1,761.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	1.59	31.80	–	–
" Cellulose,	2.59	51.80	17.61	34
" Fat,	4.43	88 60	67.34	76
" Protein (Nitrogenous Matter),	13.13	262.60	223.21	85
Non-nitrogenous Extract Matter,	78.26	1,565.20	1,471.29	94
	100.00	2,000.00	1,779.45	–

HOMINY MEAL.

[Sent on for examination from Bolton, Mass. 70.56 per cent. passed through
144 to square inch.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	8.11	162.20	–	–
Dry Matter,	91.89	1,837.80	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	3.24	64.80	–	–
" Cellulose,	4.78	95.60	32.50	34
" Fat,	12 22	244.40	185.74	76
" Protein (Nitrogenous Matter),	11.76	235.20	199.92	85
Non-nitrogenous Extract Matter,	68.00	1,360.00	1,278.40	94
	100.00	2,000.00	1,696.56	–

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cle was of a good mechanical condition, and its n notable on account of the exceptional high per- fat. The statement concerning its digestibility is hat of corn, as no actual trials in that direction to us.

MIDDLINGS.

by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
00° C., . .	9.25	185.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	1 : 4.74 to 1 : 5.
. . . . .	90.75	1,815.00			
	100.00	2,000.00			
of Dry Matter.					
. . . . .	5.34	106.80			
ose, . . .	8.40	168.00			
. . . . .	6.46	129.20			
n (Nitrogenous er), . . .	18.18	363.60			
ous Extract	61.62	1,232.40			
	100.00	2,000.00			

cle is rich in valuable constituents for feeding pur- compares favorably with those of its kind. It safe to assume the rates of digestibility noticed ran, fed to cattle, which have been repeatedly e bulletins. (See No. 11, page 5.)

Analysis of Sugarhouse Molasses.

[From Grange Store, Amherst, Mass.]

(SUGAR CANE.)

00° C., ...	22.98 per cent.
. . . . .	77.02 "
. . . . .	66.11 "
. . . . .	16.98 "
. . . . .	49.13 "
xide, ...	.19 "
s, ...	.28 "

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VALUATION OF FERTILIZERS, AN
FERTILIZER ANALYSES.

Trade Values of Fertilizing Ingredients in F
Materials and Chemicals.

	Cents per
	1884.
Nitrogen in ammonia,	22
Nitrogen in nitrates,	18
Nitrogen in dried and fine ground fish,	20
Organic nitrogen in guano and fine ground blood and meat,	18
Organic nitrogen in cotton seed, linseed meal, and in castor pomace,	18
Organic nitrogen in fine ground bone,	18
Organic nitrogen in fine medium bone,	16
Organic nitrogen in medium bone,	14
Organic nitrogen in coarse medium bone,	12
Organic nitrogen in coarse bone, horn shavings, hair, and fish scraps,	10
Phosphoric acid, soluble in water,	10
Phosphoric acid, soluble in ammonia citrate,*	9
Phosphoric acid, insoluble in dry fine ground fish, and in fine bone,	6
Phosphoric acid, insoluble in fine medium bone,	5½
Phosphoric acid, insoluble in medium bone,	5
Phosphoric acid, insoluble in coarse medium bone,	4½
Phosphoric acid in coarse bone,	4
Phosphoric acid in fine ground rock phosphate,	2¼
Potash as high grade sulphate,	7¼
Potash as kainite,	4¼
Potash as muriate,	4¼

* Dissolved from two grams of phosphate, unground, by 100 cc. neutral soluti
monium citrate, sp. gr. 1.09, in 30 minutes at 65 deg. C., with agitation once in five
commonly called "reverted" or "backgone" phosphoric acid.

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ove trade values are the figures at which, on March
espective ingredients could be bought at retail for
our markets in the *raw materials*, which are the
ource of supply.

lso correspond, as has been stated, to the average
prices for the six months ending March 1st, plus
ent. in case of goods for which we have wholesale
. The calculated values obtained by the use of
figures, will be found to agree fairly with the rea-
tail price in case of standard raw materials, such

hate of Ammonia,	Azotin,
te of Soda,	Dry Ground Fish,
ate of Potash,	Cotton Seed,
nate of Potash,	Castor Pomace,
l Blood,	Bone,

Plain Superphosphates.

Wood Ashes.

[I., II. Ashes sent on from Beverly, Mass.]
da ashes, sent on by the Secretary of the Greenfield Farmers' Club.]
[IV. Sent on for examination from Chicopee, Mass.]

	Pounds per Hundred.			
	I.	II.	III.	IV.
100° C., ...	8.80	14.40	12.93	15.73
oxide, ...	2.18	2.25	5.50	5.93
ide, ...	45.90	34.33	33.99	35.45
oxide, ...	3.63	3.13	4.22	3.41
acid, ...	2.22	1.79	2.05	1.60
atter, ...	8.86	14.40	10.42	10.29

s I. and II. are apparently partly leached; samples
V. are of a fair average composition.

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Canada Wood Ashes.

[I. E. McGarvey. Collected of Edward Swan, South Deerfield, Mass.]
[II. Munroe, Judson & Stroup, Oswego, N. Y. Collected of Walter Crafts & Whately, Mass.]
[III. Sent on for examination from Montague, Mass.]

	Pounds per Hundred.		
	I.	II.	I
Moisture at 100° C,	16.55	11.95	6
Calcium oxide,	34.42	39.60	34
Magnesium oxide,	2.52	2.28	2
Potassium oxide,	5.36	6.46	6
Phosphoric acid,	2.06	1.77	2
Insoluble matter,	24.10	10.12	16

These samples are of good composition; they are sol
25 cents per bushel on board of cars. The bushel aver
from 45 to 48 pounds.

Canada Ashes.

[I. Collected of Wm. H. Earle & Co., Worcester, Mass.]
[II. Munroe, Judson & Stroup. Collected of Albert Montague, South Dee Mass.]
[III. Munroe, Judson & Stroup. Collected of E. M. Roche, South Deerfield, M

	Pounds per Hundred.		
	I.	II.	I
Moisture at 100° C.,	3.30	11.25	13
Total phosphoric acid,	2.30	1.09	1
Potassium oxide,	8 51	6.36	5
Calcium oxide,	37.49	37.62	39
Magnesium oxide,	3.93	7.47	5
Insoluble matter,	11.60	6.37	9

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e I. sold at $14.25 per ton, counting 45 pounds the f a bushel, at 33 cents per bushel. Samples II. and at 25 cents per bushel, of from 45 to 48 pounds

Ash of Spent Tan Bark.

[Sent on for examination from North Adams, Mass.]

	Pounds per Hundred.	
	I.	II.
t 100° C.,	7.75	–
xide,	31.78	31.35
n oxide,	2.57	5.10
oxide,	1.14	2.87
acid,	2.77	1.92

ticle resembles leached wood ash, as might be ex- om the previous treatment of the hemlock bark.

Potash Salts.

[Sent on by the Secretary of the Dartmouth Farmers' Club.]
. Potash Salts, a fused hard mass, of a clayish-white color.]
Black or Blue Ash, a moist, lumpy mass, easily pulverized.]

	Pounds per Hundred.	
	I.	II.
100° C.,	1.08	14.60
oxide,	42.06	13.13
de,	24.51	4.51
	19.30	.08
cid,	1.38	7.90
atter,	1.00	3.30

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These articles are evidently waste materials from s potash industry. No. I. represents a value of from $3 $37 per ton; it contains some potassium sulphide, and ou to be exposed to the air, previous to its application, to p vent injurious influences on the young growth. No. II. c tains a considerable amount of carbonates, and is better fi for direct use as a potash source; it is worth from $1 $12 per ton.

Muriate of Potash.

[Sent on for examination by Bolton Farmers' and Mechanics' Association, Bo Mass.]

	Pe
Moisture at 100° C.,	
Potassium oxide,	5
Valuation per ton, at current rates,	$43

Muriate of Potash.

[Used at Experiment Station, 1885.]

	Pe
Moisture at 100° C.,	
Potassium oxide,	4
Valuation per 2,000 lbs.,	$4

Potash Salts.

[I. Muriate of potash, sent on from Fall River, Mass.]
[II. Muriate of potash, from H. L. Phelps, Southampton, Mass.]

	Pounds per Hu	
	I.	
Moisture at 100° C.,	2.00	
Potassium oxide,	52.00	5
Sodium oxide,	–	
Insoluble matter,	–	
Valuation for 2,000 lbs.,	$44 20	$4

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Muriate of Potash.

[Collected in Worcester, Mass.]

	Per cent.
00° C.,	1.63
ide,	53.68
ter,	.15
2,000 lbs.,	$45 63

Sulphate of Potash.

[Sent on from New York City.]

	Per cent.
00° C.,	.35
ide,	47.60
l,	44.83
ter,	.67
2,000 lbs.,	$69 02

le Sulphate of Potash and Magnesia, sent on for examination.]
Sulphate of Potash and Magnesia, sent on from Hatfield, Mass.]

	Pounds per Hundred.	
	I.	II.
00° C.,	1.95	2.73
ide,	23.37	18.92
xide,	12.86	13.08
e,	3.38	3.97
,	Not determined.	9.61
d,	45.52	41.89
	1.36	7.80
ter,	2.10	2.36

ples represent, probably, the extremes in com-
Large percentages of chlorides are, in many in-
nsidered objectionable, in high-priced sulphates.
have been offered at from $38 to $40 per ton.

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Krugit.

[Bowker Fertilizer Co., Boston, Mass.]

Moisture at 100° C.,	
Sodium oxide,	
Potassium oxide,	
Calcium oxide,	
Magnesium oxide,	
Sulphuric acid,	
Chlorine,	
Insoluble matter (in acids),	

This saline belongs to the products of the "(Potash Industry" at Strassfurt. It contains from 16 per cent. of sulphate of potassa, besides sulphate (gypsum), sulphate of magnesia, and chloride of (common salt), etc. A careful trial of the article u pastures, as a top-dressing, in connection with fine bones, deserves attention. It sold at $14 per ton o pounds, on board of cars in Boston.

Lime Kiln Ashes.

[Collected at Holyoke, Mass.]

Moisture at 100° C.,	
Calcium oxide,	
Magnesium oxide,	
Potassium oxide,	
Phosphoric acid,	
Carbonic acid,	
Insoluble matter,	

Sold at 22 cents per bushel.

The material is a fair sample of its kind.

Refuse Lime.

[Sent on for examination from Lowell, Mass.]

Moisture at 100° C.,	
Phosphoric acid,	
Magnesium oxide,	
Calcium oxide,	
Insoluble matter,	

The lime consists of a mixture of calcium oxide a bonate of lime, and is equal in pecuniary value to air- lime.

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Plaster.

Scotia plaster. Collected of B. F. Bridges, South Deerfield, Mass. Sold at $7.50 per ton.]

aster. Collected of B. F. Bridges, South Deerfield, Mass Sold at $6 per ton.]

	Pounds per Hundred.	
	I.	II.
° C.,	4.07	8.95
	33.59	29.60
	47.23	32.68
er,	-	8.95

Cayuga Land Plaster.

[Sent on for examination.]

	Per cent.
° C.,	11.56
	29.35
de,	4.76
	32.76
	7.20
r,	12.00

Sold at $6 per ton.

Boneblack Waste.

Bolton Farmers' and Mechanics' Association, Bolton, Mass.]
. Sent on for examination from Concord, Mass.]

	Pounds per Hundred.	
	I.	II.
° C.,	2.30	6.00
c acid,	30.20	27.36
r,	1.53	6.60

four cents per pound of phosphoric acid for a fine mechanical condition, Sample I. repre- of from $23 to $24, and Sample II. of from

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$21 to $22 per ton of 2,000 pounds. The valuation
articles depends somewhat on their mechanical co
They furnish a superior material for the manufac
superphosphate of lime.

Dissolved Boneblack.

[Sent on for examination by Bolton Farmers' and Mechanics' Associati
Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble " "	
Reverted " "	
Insoluble " "	
Insoluble matter,	
Valuation per 2,000 lbs.,	

Dissolved Boneblack.

[Used at Experiment Station, 1885.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble " "	
Reverted " "	
Insoluble " "	
Insoluble matter,	
Valuation per 2,000 lbs.,	

Fine Ground Bones.

[Sent on for examination from Hingham, Mass.]

	Pounds per I	
	I.	
Moisture at 100° C.,	4.05	
Total phosphoric acid,	23.77	
Reverted " "	13.65	
Insoluble " "	10.12	
Nitrogen,	3.70	
Insoluble matter,	1.50	
Valuation per 2,000 lbs.,	$43 27	

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tion of ground bones varies somewhat, on account es in their mechanical condition. The majority cles are at present of a very advantageous form.

Swift Sure Bone Meal.

[Used at Experiment Station, 1885.]

	Per cent.
0° C.,	5.60
ric acid,	20.36
"	–
"	6.63
"	13.73
	6.75
er,	.48
2,000 lbs.,	$43.89

Home-made Superphosphate.

[Sent on for examination from Marblehead, Mass.]

	Per cent.
0° C.,	26.03
ric acid,	12.78
"	10.87
"	.59
"	1.32
er,	16.04
2,000 lbs.,	$21 04

le was obtained, according to a communication y treating one thousand pounds of fine-ground ina rock phosphate with six hundred pounds of id of 66° B. specific gravity, diluted previously ual volume of water. As the mixture thus pro- ns for some time more moist than desirable, it is d to use equal *weights* of *acid* and *water*.

Fertilizing Material.

amination by Farmers' Club. Lanesborough, Mass. No guarantee obtained.]

	Per cent.
0° C.,	10.59
ric acid,	12.06
"	6.78
"	3.34
"	1.94

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Potassium oxide, ...
Nitrogen, ...
Insoluble matter, ...

Valuation per 2,000 lbs., ...

Complete Fertilizer.

[Sent on for examination by Farmers near Worcester, Mass.]

Moisture at 100° C., ...
Total phosphoric acid, ...
Soluble " " . . . . . .
Reverted " " . . . . . .
Insoluble " " . . . . . .
Potassium oxide, ...
Nitrogen, ...
Insoluble matter, ...

Valuation per 2,000 lbs., ...

Fertilizing Materials.

[Sent on from Boston, Mass.]

	Pounds per
	I.
Moisture at 100° C., ...	4.10
Phosphoric acid, ...	1.77
Potassium oxide, ...	1.35
Nitrogen, ...	1.33
Calcium oxide, ...	11.44
Magnesium oxide, ...	1.36
Insoluble matter, ...	48.35

The materials are evidently mixtures of refuse from
ous sources, and contain large quantities of insoluble
ter. No. I. is worth from $7 to $8 per ton, and N
from $2.50 to $3.

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Fish Waste.

[om the Secretary of Hampshire, Franklin and Hampden Society.]

	Per cent.
100° C.,	41.92
horic acid,	5.20
"	.83
"	2.02
"	2.35
	7.60
atter,	.28
er 2,000 lbs,	$34.37

Ammonite.

[Sent on by Secretary of Hatfield Grange.]

teed composition: Ammonia, 15 to 16 per cent. nt to nitrogen, 12.4 to 13.2 per cent.); phosphoric 6 per cent.

	Per cent.
100° C.,	5.88
horic acid,	3.43
=ammonia, 13.76 per cent.),	11.33
atter,	1.38
er 2,000 lbs.,	$44.90

icle consists, evidently, of fine-ground animal mat- from fat. Its general physical character is appar- orable to a speedy disintegration. The material ttention as a source of nitrogen for plant growth.

Dried Blood.

for examination by Bolton Farmers' and Mechanics' Association, Bolton, Mass.]

	Per cent.
100° C.,	7.65
	8.10
acid,	6 23
atter,	1.08
er 2,000 lbs.,	$36.64

Dried Blood.

[Used at Experiment Station, 1885.]

	Per cent.
100° C.,	16.10
	12.49
er 2,000 lbs.,	$44.96

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Nitrate of Soda.

[Sent on for examination by Bolton Farmers' and Mechanics' Associatio
Bolton, Mass.]

	P
Moisture at 100° C.,	
Nitrogen,	1
Valuation per 2,000 lbs.,	$

Saltpetre Waste.

[Sent on from Acton, Mass.]

	P
Moisture at 100° C.,	
Sodium oxide,	4
Potassium oxide (largely chloride),	
Nitrogen (in nitrates),	

The sample represents a trade value of from $10 to
per ton, and will prove quite effective upon grass lands
in case of forage crops in general.

Ammonium Sulphate.

[Sent on for examination by Bolton Farmers' and Mechanics' Association
Bolton, Mass.]

	P
Moisture at 100° C.,	
Nitrogen,	2
Valuation per 2,000 lbs.,	$7

Ammonium Sulphate.

[Used at Experiment Station, 1885.]

	P
Nitrogen,	2
Valuation per 2,000 lbs.,	$7

Cotton-seed Meal (Coarse).

	P
Moisture at 100° C.,	
Organic and volatile matter,	9
Ash constituents,	
Phosphoric acid,	
Potassium oxide,	
Calcium oxide,	
Magnesium oxide,	
Nitrogen,	
Insoluble matter,	
Valuation per 2,000 lbs.,	$2

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aken from a Ditch in a Diked Marsh at East Salisbury, Mass.

[Sent on for examination.]

	Per cent.
00° C.,	33.40
volatile matter,	92.15
	7.85
	4.20
e,	3.65
organic matter),	1.64
cid,	.13
ide,	.26
le,	1.24

erial is quite rich in manurial substances, and is at respect, to the better quality of peat.

Muck.

amples of Muck sent on for examination from Goshen, Mass.]

	Pounds per Hundred.		
	I.	II.	III.
00° C.,	63.75	66.80	43.18
	36.25	33.20	56.82
	17.30	8.55	26.12
rganic matter,	.75	1.09	.97

No. I. consisted of a solid, unbroken, turfy mass, tle change in the original vegetable structure. It ome lime, with traces of phosphoric acid, as more mineral constituents. The nitrogen of the vege- r is that of a fair quality of its kind, considering nount of earthy material present.

No. II. consisted of a black-brown, somewhat pul- ass, with rootlets here and there interspersed; it ore lime and phosphoric acid than No. I., but less ter. The smaller percentage of mineral matter fficiently for an increased amount of nitrogen as vith No. I.

No. III. consisted mainly of a material similar to

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No. II., covered largely with a grayish saline mass acid and astringent taste. Treated with water, at a nary temperature, a very acid solution was obtained, contained a liberal amount of free sulphuric acid, be considerable quantity of the combination of this ac lime (gypsum), and with oxide of iron (green cop The presence of these compounds was evidently due action of air and of moisture on iron pyrites, — a co tion of sulphur and iron, — contained in the rocks a soils through which the water percolated which fi muck-bed.

Wells located in rocks containing iron pyrites are show a similar alteration in their character during the part of the spring, after a dry summer and autumn, in consequence of a lower level of the water supply, extensive exposure of adjoining rocks has favor oxidation of both iron and sulphur. This change n sume such proportions at times, that the water of thes will curdle fresh milk, and produce a more or less i abstract of green tea.

A repeated pumping-out, in most instances, remov cause of these reactions. An actual observation in thi tion at Amherst, a few years ago, after several years seasons, furnished a striking illustration of the p statement.

A muck like No. III. is decidedly injurious to vege and needs an exceptionally large addition of lime or and a longer exposure to the air than the average n of this kind, to prepare it for manurial purposes.

Sumac.

[Waste material from Tanneries in Peabody, Mass. Sent on by the Mas Society for Promoting Agriculture.]

Moisture at 100° C.,	
Organic matter,	
Nitrogen in organic matter,	
Crude ash in organic matter,	
Calcium oxide in ash,	
Magnesium oxide in ash,	
Potassium oxide in ash,	
Phosphoric acid,	
Insoluble matter in ash,	

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gen, potash and phosphoric acid contained in the le represent a commercial value of $3.50 to $4 ,000 pounds. The tanning principle was so com- racted that a composting with some air-slacked ses to render the material quite valuable as a bstance for light soils, deficient in organic matter.

Kentucky Tobacco Stems, Ground.

[Sent on for examination.]

	Per cent.
00° C.,	12.180
	87.820
organic matter),	2.616
ide,	8.816
xide,	1.395
e,	3.720
id,	.726

cle is valuable for fertilizing purposes, and de- special attention of tobacco-growers. Its trade rtilizing constituents amounts to from $15.50 to of 2,000 pounds, at current rates of valuation.

Analyses of Cotton Waste.

[Sent on from Bedford, Mass.]

	Pounds per Hundred.	
	Wet.	Dry.
00° C.,	34.69	5.53
id,	1.54	.84
xide,	1.13	.87
e,	2.45	1.45
ide,	.80	.89
	1.30	1.32
tter,	41.33	49.68
	$7.21	$6.52

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Ash of Corn Cobs.

[Republished at request.]

Moisture at 100° C., ...
Ash (average of seven analyses), ...

One hundred parts of crude cob ash, dissolved in h
chloric acid, contained the following elements in the
proportions: —

	Wheeler's Prolific.	Southern Corn.	Canada Corn.	Western (Yellow) Dent Corn.	L
Silica, soluble in soda, .	17.344	20.819	10.314	25.478	
Ferric oxide, . . .	trace.	1.249	6.687	.621	
Calcium oxide, . .	2.189	3.066	2.372	2.293	
Magnesium oxide, . . .	5.317	4.561	4.989	3.976	
Potassium oxide, . .	60.129	59.818	62.362	54.231	
Sodium oxide, . .	5.745	2.293	2.907	8.302	
Phosphoric acid, . .	9.185	8.026	10.363	5.098	

The samples which served for the above analyses
raised under varying conditions; one being obtained
South Carolina, another from Illinois, and the rem
three from this vicinity. The sample of Canada Corn
the result of high fertilization. For further detail
"Analyses of Different Varieties of Corn," in Rep
Secretary Massachusetts Agricultural Society, 187
page 238.

Analysis of Wheat Bran, with reference to its Ferti Constituents.

Moisture at 100° C., ...
Phosphoric acid, ...
Calcium oxide, ...
Magnesium oxide, ...
Sodium oxide, ...
Potassium oxide, ...
Nitrogen (in dry matter), ...
Insoluble matter, ...

Valuation per 2,000 lbs., ...

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Analyses of Drinking Water.

[Composition of One Million Parts.]

SAMPLE.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids.	Hardness (Clark's degrees).
. .	0.06	0.35	3.60	270.0	3.90
. .	0.03	0.07	2.25	130.0	–
. .	0.06	0.36	22.00	–	–
. .	0.01	0.13	–	35.0	–
. .	0.02	0.17	0.40	80.0	–
. .	0.20	0.20	15.70	39.0	0.30
. .	0.01	0.34	–	–	–
. .	0.04	0.25	–	46.5	1.11
. .	0.01	0.05	–	52.0	1.43
. .	0.06	0.16	18.00	230.0	7.71
. .	0.05	0.14	–	44.0	2.47
. .	0.07	0.14	–	128.0	6.71
. .	0.05	0.15	8.00	65.0	2.21
. .	1.02	0.35	8.00	94.0	2.60
. .	0.06	0.11	9.90	88.0	2.47
. .	0.27	0.27	42.00	222.0	7.43
. .	0.05	0.15	11.00	76.0	–
. .	0.02	0.08	17.00	204.0	6.57
. .	0.21	0.17	12.00	96.0	1.82
. .	0.08	0.18	13.00	70.0	1.11
. .	0.03	0.08	17.00	160.0	4.86

nalyses were made in accordance with requests rom all parts of the State.

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METEOROLOGY.

The regular meteorological observations, commenc the Station in 1884, have been carried out as pro during 1885. Their plan comprises the general r recommended to the voluntary observers of the U States Signal Service; viz., tri-daily observations upo perature, relative humidity, precipitation and general tion of the sky.

The records given here are the results of the first observations made at the Station. They have a direct in connection with the Station work, as furnishing add data bearing on the field experiments; and, beyond thi tribute something to the mass of meteorological r sought for by the Signal Service. In the latter conn monthly reports of observations have been rendered Chief Signal Officer. Copies of the records have als contributed to the New England Meteorological Soc the close of each month, and published in its bulletin.

The daily "Farmers' Bulletin," issued by the Signa vice, was received by the Station until its publicati discontinued in July. A valuable feature of these bu was the cold wave predictions, which were indicated Station by the display of the appropriate signal, — a flag with black center. This warning was hoisted times in the months of January, February and Marc in every case was justified by a marked fall in tempe during the succeeding twenty-four hours. The mean the signal was beginning to be understood; and, coul warnings have been given in the fall months, the sea their greatest importance, their value would have

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le. Daily weather signals are now displayed
ne large towns and cities of the State. The
s a trifling expense, and it seems desirable that
should participate in an undertaking of such
le importance to the agricultural community.
tical periods in all farm operations, when fore-
storm or frost, such as are now disseminated
ness and accuracy, would be of great value to
f available. As a scientific institution devoted
al interests, the Station ought to assist in this
will be able to do so during the coming year, as
main office is located on the grounds of the

sidered, the more important local meteorologi-
of the year were the severity of the winter, the
nth and abundant rainfall of the summer season,
racted mildness of the fall months. The tem-
January, February and March, was below the
ecords kept in Amherst since 1836, while that
and March was absolutely lower than for any of
nding months in this period.*
nportant snowfall of the year occurred January
sleighing lasted from this time until March 26.
ount of snow precipitated during these months
ches.. Melting snow fell April 29, and the sur-
round froze and ice formed May 4. The last
occurred May 10, 11, and 12, although a slight
ed on lowlands June 10. The following table
mparison between the rainfall and temperature
g and fall months, arranged in fortnightly
the averages of similar periods for the forty-
ing years: —

from records of Amherst College, published in the Second Annual
periment Station.

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	April, Last 15 Days.	May, First 15 Days.	May, Last 16 Days.	June, First 15 Days.	Aug., Last 15 Days.	Sept., First 15 Days.	S La D
Precipitation.							
Average for 48 years,	1.73 in.	2.06 in.	1.86 in.	1.81 in.	2.02 in.	1.46 in.	1.
For 1885, . . .	1.78 in.	1.01 in.	2.07 in.	1.61 in.	3.45 in.	0.69 in.	1.
Temperature.							
Average for 48 years,	48.6°	57.0°	60.4°	64.9°	67.5°	64.3°	5
For 1885, . . .	51.6°	46.9°	61.1°	60.7°	63.2°	59.9°	5

The first frost of fall was reported on lowlands 27, but no damage was done. Other light frosts September 3, 6, 11, and 12. The first killing fr October 7, but many of the more hardy herbaceo were but little injured at the close of this month. respect, therefore, the season was favorable; since th previously referred to show that the average date o frost in spring, from 1836 to 1885, was May 16, a earliest frost in fall, September 20. The first sno winter of 1885–1886 came November 22–26, and to about one inch in depth. December 18 there wa five inches, — a total of six inches for the months of N and December, and 37.68 inches for the entire year

The prevailing direction of the wind, as taken monthly summaries, gives 41.7 per cent. from th west, 41.7 per cent. from the north-west, 8.3 per c the north, and 8.3 per cent. from the west.

Rain or snow fell in a measurable quantity on during the year. The greatest number of such da one month was 13, in August; and the fewest 4, i Of "clear" days — *i.e.*, those when the sky was four-tenths overcast at each observation — there we which January had the most of any month, 9, and M fewest, 1.

The "cloudy" days, or those on which the sky than seven-tenths obscured at each observation, n 69, of which May had the most, 11, and July the f

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ing 233 days were "fair," having the sky from
n tenths obscured at each observation.
ost temperature of the year was 93.0°, occurring
the lowest −18.0°, on January 28. From these
obtained the absolute range of temperature for
z., 111.0°.

Miscellaneous Phenomena. — Dates.

Frost.	Snow.	Rain.	Thunder Storms.	Solar Halos.	Lunar Halos.
13, 14, 15, 31.	17, 21, 28.	6, 12, 17.	-	-	-
9, 13.	1, 5, 8, 10, 14, 16, 18.	9, 16, 25.	-	-	-
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-	-	2, 3. 4, 5, 6, 7, 9, 10, 14, 21, 26.	2, 4, 9, 21.	13.	-
27.	-	1, 2, 3, 4, 5, 10, 11, 13, 18, 19, 21, 22, 23, 24, 25, 30, 31.	1, 3, 5, 17, 22.	-	-
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7, 8, 10, 22, 23, 24, 25, 26.	-	3, 4, 6, 13, 14, 21, 29, 30.	4.	-	-
3, 14, 16, 18, 20, 21, 27, 28, 29, 30.	22, 23, 24, 25, 26.	1, 2, 5, 6, 7, 8, 19, 20, 25.	-	12, 14.	-
22, 23, 30.	3, 4, 8, 13, 18.	4, 9, 14, 23, 31.	-	-	-

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Summary of Meteorological Observations, 1885.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . .	19.5	26.6	22.4	22.7	33.2	9.4	23.8	57.0	12th	— 18.0	29th	83.9	81.8	79.2	81.7	3 78	15th to 17th.
February, . .	8.8	20.7	15.6	15.2	25.6	0.1	25.5	44.0	28th	— 15.0	12th	81.6	79.8	83.5	81 7	3.88	8th to 10th.
March, . . .	17.1	29.5	23.3	23.3	32.8	9.1	23.7	50.0	28th	— 11.0	18th	85.4	82.3	87.7	85.3	0.86	29th.
April, . . .	36.8	54.6	45.4	45.3	58.0	29.4	28.6	83.0	22d	19.0	15th	85.5	62.7	69.1	72.6	3.38	28th to 29th.
May, . . .	48.2	62.6	54.1	54.8	65.5	40.1	25.4	85.0	19th	21.0	4th	80.1	61.5	75.1	73.0	3.08	30th to 31st.
June, . . .	56.2	73.2	62.7	63.8	76.0	48.3	27.7	89.0	16th	35.0	10th	89.1	62.7	77.8	76.2	3.49	5th.
July, . . .	63.7	79.8	69.1	70.4	82 9	53.8	29.1	93 0	9th	41.0	2d	88.0	58.9	83.9	77.2	2.07	9th.
August, . . .	60.5	74.6	64.6	66.1	77.0	51.0	26.0	87.0	18th	34.0	28th	90.3	64 7	83.6	79 5	8.31	4th.
September, . .	49.7	68.3	57.7	58.3	71.0	38.4	32.6	81.0	14th	30.0	12th	94.7	68.3	84.3	82.3	0.85	8th.
October, . . .	42.8	57.8	48.0	49.1	60.1	37.0	23.1	80.0	4th	29.0	8th	95.1	69.2	84.6	82.6	3.65	21st.
November, . .	35.4	44.3	40.1	39.8	48.3	30.2	18.1	70.0	8th	11.0	29th	93.6	78.3	83.8	84.1	5.54	5th to 9th.
December, . .	25.3	33.2	30.0	29.6	39.2	18.4	20.8	65.0	10th	6.0	22d	–	–	–	–	3.54	14th.

April 6,	State Treasurer,	1,250 00	Printing and Postage,	557 08
17,	Dr. C. A. Goessmann, Director,	162 87	Office Expenses,	143 71
July 6,	State Treasurer,	3,750 00	Farmer and Farm Labor,	1,275 64
14,	Dr. C. A. Goessmann, Director,	62 72	Farm Supplies,	530 48
Oct. 2,	State Treasurer,	2,500 00	Stock and Feed,	672 13
Nov. 21,	State Treasurer, on account of Agricultural College, for Gas Machine,	566 00	Miscellaneous Expenses,	158 52
			Old Bills, Carpenter and Agricultural College,	1,300 22
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OURTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

State Agricultural Experiment Station,

AT

HARVARD COLLEGE

AMHERST, MASS.

1886.

BOSTON:
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THE NEW CHEMICAL LABORATORY OF THE MASSACHUSETT
AGRICULTURAL EXPERIMENT STATION.

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FOURTH ANNUAL REPORT

OF THE

OARD OF CONTROL

OF THE

STATE

ULTURAL EXPERIMENT STATION,

AT

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MASSACHUSETTS STATE

CULTURAL EXPERIMENT STATION,

AT AMHERST, MASS.

BOARD OF CONTROL, 1886.

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President of Massachusetts Agricultural College.

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HEELER, B. S., . . *General and Analytical Chemistry.*
P E. STONE, B. S.,* . *Biology and Field Experiments.*
LLEN, B. S., . . *General and Analytical Chemistry*
ELPS, B. S., . . *Analytical Chemistry and Stock-feeding.*
ENTZELL, . . . *Farmer.*

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* Left July 1, 1886.

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BOSTON, Jan. 11, 1887.

able the Governor and Council, State of Massachusetts.

dance with the law of the State, I have the honor to
Fourth Annual Report of the Board of Control of
gricultural Experiment Station.

ALVAN BARRUS,

Secretary.

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FOURTH ANNUAL REPORT

OF THE

R OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

---

rable Board of Control.

MEN : — The past year has been one of marked activity tory of the Station. The additional appropriation the Legislature of 1886, for finishing and fitting up cal laboratory, has rendered it possible to finish the ccording to the design adopted by the Board, and to with a gas machine, a heating apparatus, and such pliances as are indispens... to meet the purpose for as been erected.

building has been added to those already existing for ts in stock feeding. The structure is of wood ; clap- tside and sheathed inside ; fifty-six feet long, twenty- de, with posts twelve feet high. It is well lighted ated, and contains six separate stalls for cows and rses.

lding for feeding experiments with pigs and sheep removed to a more convenient locality for the work under its roof. This change in its position has ren- e compact the entire arrangements for keeping the nds of farm live-stock for feeding experiments, and ultimately good economy in various directions.

ed passage, seven feet wide and thirty feet long, has to connect the feed-room and its scales for weigh- ily fodder rations, by rails, with the stalls occupied mals on trial. The building, originally intended for paratus and engine, has been enlarged nine feet in twelve feet in width, to serve in the near future for ement of the milk-setting apparatus.

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The dwelling-house occupied by the farmer, as well principal barn and the sheds, have been kept in good No alterations of any consequence have been made in buildings. The contemplated changes are confined to the they are of no particular importance as far as expenses a cerned, and may be attended to whenever circumstances it advisable.

The entire expenses, arising from the increase an improvement of farm buildings, have been paid fro regular annual income of the Station.

The work in the field has been on a more extensive than in any preceding year, for new lands have been ad those occupied during the past. The grounds assigned Station at the beginning of its existence consisted of two situated at some distance from each other. One field, three acres in size, which had been used for a series of for experiments with fruit, was returned three yea to the College. The other, which comprises an area of acres, has remained ever since under the control of th tion. Upon these grounds are located all buildings and e mental fields described in this and in the three preceding reports.

The new lands added during the past season, in conse of an agreement between the Board of Trustees of the Agricultural College and the Board of Control of the Agricultural Experiment Station, consists of twenty ac unimproved grass land and of about ten acres of wood The entire field is a part of the western slope of a pro and extended elevation, covered with a dense natural growth. The wood-land assigned to the Station stretches the western termination of the grove; it reaches to the c the hill, and has been secured to enable the control of the shed towards the adjoining lower grounds. Three thousa eight hundred feet of drain tiles have been laid to impro growth on the lowlands. Twelve acres of the old gras have been turned over to renovate the soil during the c season by drill cultivation of suitable crops. It is pro subsequently, to turn the more elevated portion of these to account for experiments with fruit trees, and to raise

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ler, according to particular location, either general
or utilize them as permanent meadows.

occupied by field experiments upon the old grounds
nsiderably enlarged. The number of separate fields
ncreased; their outlines have been established
to permanency, wherever the soil has attained a
iformity as far as its state of cultivation, as well as
n and character of its latent resources of plant food
ed. To secure the latter condition as soon as
one and the same mixture of manurial matter —
es and muriate of potash — has been used since the
nt of the Station, whenever a general good state of
was needed in the interest of success. Four
ls, each more than one acre in size, have been thus
o serve, if necessary, for years, for some definite
rvations. The experimental work carried on in
e field and the laboratory during the past year is
the subsequent pages under the following head-

ments with milch cows to ascertain the feeding value of
a substitute for English hay, and that of corn ensilage
with beet roots.

es of fodder articles with reference to their nutritive
panied by a short exposition of the leading principles
the basis for determining the comparative feeding value
articles in a rational system of stock feeding.

es of some prominent feed stuffs, with reference to the
stituents they contain.

best condition of fodder corn for the silo.

corn raised on underdrained and exhausted lands, partly
one single article of plant food, partly without the use
ial matter.

ce of fertilizers on the quantity and the quality of some
ps, — corn and four grasses.

ments with some prominent fodder crops to furnish a
pply of green fodder for dairy stock, — oats, vetch,
Southern pea vines.

ments with potatoes.

aneous field experiments.

ers and fertilizer analyses; miscellaneous analyses.

ater analyses.

ological observations.

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It may be noticed from the above statement that som reported experiments are continuations of inquiries inau in previous years, while others are the natural outgro preceding investigations; some open new lines of obse

Considerable attention has been devoted during t year to constructing buildings, providing a better outfit chemical laboratory and for the stock-feeding depa The new year cannot otherwise but materially benefit f change. The periodical publications of the Station h been as numerous during the preceding year, on acc temporary interruptions in the work in consequence o caused by the erection of new buildings and the remode old ones. The interest in the bulletins and annual rep been steadily increasing throughout all parts of the S elsewhere. The printing of bulletins has been increas three thousand five hundred in 1885, to five thousan each in 1886. The second annual report is entirely print, and but few of the first and third reports are sti disposal. None of the bulletins, Nos. 1 to 16, are o the same is the case with No. 20 of the last year. Th cation will be resumed at an early date.

The support received from all parties connected w work of the Station has been very satisfactory.

Permit me to thank you sincerely for the hearty enc ment and the kind support I have enjoyed in carrying work assigned to me.

Yours very respectfully,

C. A. GOESSMANN,
Director of the State Agricultural Experimen

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EEDING EXPERIMENTS.

C. A. GOESSMANN.

1. Experiments with Milch Cows.

g experiments described within a few subsequent
hiefly instituted for the purpose of studying the
e of dried corn fodder (stover) as a substitute for
and of beet roots as compared with corn ensilage.
tions made in this connection extended over a
arly eight months, — November, 1885, to July,

, crosses of native stock and Ayrshires, and both
even years old, served for the trial. They were in
ilking period, four weeks after calving, at the
the experiments. The changes in diet, whenever
n, were made gradual, to prevent any serious dis-
he general condition of the animal on trial. As a
ur to five or more days were allowed to pass by, in
nge of food, before a record of the daily yield of
ade for the purpose of comparing the effect of
der rations.

tion of the various fodder articles consumed is
local market prices, per ton, at the time of their
English hay, $15; corn meal, $23; wheat bran,
orn fodder (stover), $5; corn ensilage, $2.75;
oved Sugar Beet, $5.

diet of both cows consisted at the beginning of the
of three and one-quarter pounds of corn meal, an
of wheat bran and all the hay they would eat.

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The actual amount of hay consumed, in each case, wa tained by weighing out daily a liberal supply of it and d subsequently the hay left over. The same fodder mi far as quality and quantity are concerned, was also some time as daily feed at the close of the exp This course was adopted for the purpose of ascertai natural shrinkage in daily yield of milk during t engaged by the experiments (from seven to eight mont amounted, as may be noticed in the subsequent detailed to nearly 50 per cent. of the original yield of milk.

The above-stated combination of fodder articles was as the basis of our investigation, mainly for the reason had been used with satisfactory results in some of ou feeding experiments, and not on the assumption of its b best possible combination of fodder articles for milch c

The value of a fodder for dairy purposes may be stat two distinctly different standpoints, — namely, with refe its influence on the temporary yield of milk, and the condition of the animals which consume it; and in rega first cost, *i. e.*, its physiological and its commercial val

The market price of our fodder articles depends supply and demand in the general market; its determi beyond the control of the individual farmer. The mark of hay of the same quality may vary widely in differe and in different localities; its feeding value remains m the same, under corresponding circumstances, year afte

The market value and actual feeding effect of one same article do not necessarily correspond with each o fact, they rarely coincide.

The market value may be stated for each locality definite number. *The feeding effect* of one and the sa stance, simple or compound, varies under different stances, and depends in a controlling degree on its j use. Sugar fed without any suitable admixture has no value; it is worthless as the sole food of an animal. supplemented,— as, for instance, in the sweet corn,— i tive value is very great. Bread has a high feeding v man; a cat fed exclusively with bread dies, after some with the symptoms of starvation.

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gle plant or part of plant has been found to supply
and efficiently to any considerable extent the
various kinds of farm stock, it becomes a matter
rtance to learn how to *supplement* our leading farm
et the divers wants of each kind. To secure the
ng value of each article of fodder is most desirable
est of good economy. The judicious selection of
for a suitable and remunerative diet for our dairy
s us, therefore, to study the value of the fodder
ur disposal from both standpoints.

ical analyses of the various articles used in the
of fodder in our case, are stated in some succeed-
show their character and their respective quality.
the chemical composition of a fodder ration in
with an otherwise carefully managed feeding experi-
es us to recognize, with more certainty, the causes
g feeding effects of one and the same fodder article,
different combinations. It furnishes also a most
de in the selection of suitable commercial feed stuffs
sources to supplement economically our home-
r crops. Practical experience in feeding stock has
ced, that it seems to need no further argument to
a matter of fact, that the efficiency of a fodder
dairy does not depend on the mere presence of
of certain prominent fodder articles, but on the
a proper quantity and a certain relative proportion
minent constituents of plants, which are known to
for a successful support of life and the special
the dairy cow.

ions into the relations which the various prominent
of plants bear to the support of animal life, have
advisable to classify them in this connection into
s,—mineral constituents, and nitrogenous and non-
organic constituents. For details regarding this
ve to refer to previous publications of the Station.
and extensive practical feeding experiments, with
prominent fodder articles in various conditions,
ll kinds of farm live stock, have introduced the
reporting together with analysis of the chemist, the

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results of careful feeding experiments, as far as th
fodder articles have proved digestible, and were thus
for the support of the life and the functions of the
kind of animal on trial. In stating the amount of th
ble portion of the fodder consumed in a feeding expe
has also proved useful for comparing different fodde
etc., to make known by a distinct record the relativ
tion which has been noticed to exist, between the a
nitrogenous constituents and the non-nitrogenous
constituents. This relation is expressed by the
"Nutritive Ratio." An examination of the subsequ
description of our feeding experiments will show, for
that the corn meal we fed contained one part of
nitrogenous matter, to 8.76 parts of digestible non-nit
organic matter, making the customary allowance for t
physiological value of the fat as compared with that
sugar, etc. (2.5 times higher). The "Nutritive
the corn meal is subsequently stated as follows 1 : 8.
different combinations of fodder articles, to constitute
diet during different feeding periods, vary as far as th
tive ratios are concerned from 1 : 6.7 to 1 : 10.17. T
relation (1 : 6.7) was obtained by an exceptionally larg
of roots, with hay and wheat bran without corn meal;
wider relation (1 : 10.17), by feeding a liberal amoun
ensilage with hay and corn meal without bran. A cl
tion of nitrogenous and non-nitrogenous digestible co
of an otherwise suitable fodder mixture is considered
essary for growing animals and dairy cows, than for f
animals and moderately worked horses and oxen.
investigators recommend for dairy cows a diet which
to a nutritive ratio of 1 : 5.4. Arrangements will
during the coming winter season to repeat our feedin
ments with essentially the same coarse fodder arti
modified by a suitable increase and addition of con
feed stuffs to secure daily diet of a closer nutritive r
has been used on the present occasion.

An examination of the subsequent tabulated stateme
results of our experiments shows, among other interest
the marked influence of the feeding of dried corn fodd

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ge as a substitute for a part of the English hay, on
the production of milk. Not less striking is the
nfluence of a moderate amount of roots, as a substi-
part of the hay, on the quality of milk. A numeri-
sion of the influence of the yield of milk in case of
ows, as well as at different milking periods of the
under the same system of feeding, on the cost of its
, may not be without some interest, when entering
ious discussion of the question, What kind of cows
e removed from our dairy stock in the interest of
omy?

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Record of Daisy.

Feeding Periods.	Feed Consumed (lbs.) per day.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	
	Wheat Shorts.	Corn Meal.	Corn Fodder.	Hay.	Ensilage.	Roots.				
1885. Nov. 20 to Dec. 7,	3.25	3.25	–	20.00	–	–	24.06	16.3	1.48	1:
Dec. 19 to 29,	3.25	3.25	8.00	10.00	–	–	21.64	15.4	1.45	1:
1886. Jan. 3 to 22,	3.25	3.25	12.00	5.00	–	–	20.44	14.2	1.44	1:
Feb. 1 to 17,	3.25	3.25	–	15.00	–	27.00	23.91	14.2	1.68	1:
" 20 to 28,	3.25	–	–	15.00	–	27.00	21.06	13.2	1.60	1:
Mar. 1 to 8,	3.25	–	–	15.00	–	40.00	23.18	13.3	1.74	1:
" 12 to 22,	3.25	3.25	–	15.00	–	27.00	23.89	14.2	1.68	1:
" 25 to Apr. 13,	3.25	3.25	–	14.60	20.63	–	23.73	12.8	1.85	1:
Apr. 18 to May 6,	3.25	3.25	–	10.00	29.71	–	21.51	11.0	1.91	1:
May 20 to 31,	–	3.25	–	5.00	41.75	–	16.83	9.2	1.83	1:
June 4 to 14,	3.25	–	–	5.00	41.36	–	16.76	8.9	1.88	1:
" 26 to July 4,	3.25	3.25	–	20.00	–	–	24.04	8.4	2.86	1:

Record of Mollie.

Feeding Periods.	Feed Consumed (lbs.) per day.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	
	Wheat Shorts.	Corn Meal.	Corn Fodder.	Hay.	Ensilage.	Roots.				
1885. Nov. 20 to Dec. 7,	3.25	3.25	–	20.00	–	–	24.06	12.62	1.93	1:
Dec. 19 to 29,	3.25	3.25	8.00	10.00	–	–	21.64	11.86	1.82	1:
1886. Jan. 3 to 22,	3.25	3.25	13.35	5.00	–	–	21.75	13.87	1.56	1:
Feb. 1 to 17,	3.25	3.25	–	15.00	–	27.00	23.91	11.16	2.14	1:
" 17 to 28,	3.25	–	–	15.00	–	27.00	21.06	13.2	1.60	1:
Mar. 1 to 8,	3.25	–	–	15.00	–	40.00	23.18	10.6	2.19	1:
" 12 to 22,	3.25	3.25	–	15.00	–	27.00	23.89	11.1	2.15	1:
" 25 to Apr. 13,	3.25	3.25	–	14.20	22.27	–	23.74	11.2	2.12	1:
Apr. 18 to May 6,	3.25	3.25	–	10.00	29.82	–	21.58	10.6	2.04	1:
May 20 to 31,	–	3.25	–	5.00	36.83	–	16.64	8.9	1.87	1:
June 4 to 14,	3.25	–	–	5.00	40.63	–	16.59	9.1	1.82	1:
" 26 to July 4,	3.25	3.25	–	20.00	–	–	24.04	8.6	2.80	1:

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Cost of Feed Per Quart of Milk.

(DAISY.)

	Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Corn Fodder Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Roots Consumed during Period.	Total Cost of Fodder Consumed during Period.	Average Cost of Feed for Production of One Quart of Milk for Period.
	Qts.	*Qts.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*		*Cents.*
7,	292.5	16.3	58.50	58.50	-	360.00	-	-	$3.96	1.35
.	169 0	15.4	35.75	35.75	88.00	110.00	-	-	1.81	1.07
.	283 5	14.2	65.00	65.00	240 00	100.00	-	-	2.75	0.97
.	241.5	14.2	55.25	55.25	-	255.00	-	459.00	4.25	1.76
.	118.5	13.2	29.25	-	-	135.00	-	243.00	1.91	1.61
.	106.5	13.3	26.00	-	-	120.00	-	320.00	1.96	1.84
.	156.5	14 2	35.75	35.75	-	165.00	-	297.00	2.75	1.76
13,	256.2	12.8	65.00	65.00	-	292.00	412.50	-	4.12	1.61
6,	209.5	11.6	61.75	61.75	-	190.00	564 50	-	3.49	1.67
.	112.7	9.2	-	39.00	-	60.00	501.00	-	1 55	1.37
.	98.0	8.9	35.75	-	-	55.00	455.00	-	1.36	1 39
4,	75.5	8.4	29.25	29.25	-	180.00	-	-	1.99	2.64

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Cost of Feed per Quart of Milk.

(MOLLIE.)

FEEDING PERIODS.	Total Quantity of Milk Produced during Entire Period.	Average Daily Yield of Milk for Period.	Total Amount of Shorts Consumed during Period.	Total Amount of Corn Meal Consumed during Period.	Total Amount of Fodder Corn Consumed during Period.	Total Amount of Hay Consumed during Period.	Total Amount of Ensilage Consumed during Period.	Total Amount of Roots Consumed during Period.	Total Cost of Fodder Consumed during Period.
	Qts.	*Qts.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Nov. 20 to Dec. 7,	227.5	12 6	58 50	58.50	–	360.00	–	–	$3.96
Dec. 19 to 29, .	130.5	11.9	35.75	35.75	88 00	110.00	–	–	1.81
Jan. 3 to 22, .	277.5	13.9	65.00	65.00	271.00	100.00	–	–	2.82
Feb. 1 to 17, .	189.8	11.2	55.25	55.25	–	255.00	–	459.00	4.25
" 20 to 28, .	96 0	10.6	29.25	–	–	135.00	–	243.00	1 91
Mar. 1 to 8, ,	84.5	10.6	26.00	–	–	120.00	–	320.00	1 90
" 12 to 22, .	122.0	11.1	35.75	35.75	–	165.00	–	297 00	2 75
" 25 to Apr. 13,	223.5	11.2	65 00	65.00	–	284.00	445.50	–	4.11
Apr. 18 to May 6,	190.3	10.0	61 75	61.75	–	190.00	566 50	–	3.49
May 20 to 31, .	107.0	8.9	–	39 00	–	60 00	442.00	–	1.47
June 4 to 14, .	100.5	9.1	35.75	–	–	55.00	447.00	–	1.35
" 26 to July 4,	77.0	8.6	29.25	29.25	–	180.00	–	–	1.99

Analyses of Milk.

(DAISY.)

	1885. Nov. 25.	Dec. 15.	1886. Jan. 6.	Feb. 18.	Feb. 25.	Mar. 4.	Mar. 18.	April 19.	May 14.	May 29.	June 15.
Water, . .	87.56	87.65	88.08	86.18	86 62	86.78	85.81	85.97	87 02	87.10	86.75
Solids, . . .	12.44	12.35	11.92	13 82	13.38	13.22	14.19	14 03	12.98	12.90	13 25
Fat (in solids), .	3.28	3.56	2 29	4.58	4 30	4.30	4.54	4.93	4.05	4 20	4 02

(MOLLIE.)

	1885. Nov. 25.	Dec. 15.	1886. Jan 6.	Feb. 18.	Feb. 25.	Mar. 4.	Mar. 18.	April 19.	May 14.	May 29.	June 15.
Water, . .	87.16	87.35	87.67	86 35	87 04	87.06	86.61	86 33	87.30	87 25	86.50
Solids, . . .	12.84	12.65	12.33	13.65	12.96	13.94	13.39	13 67	12.70	12.75	13.50
Fat (in solids), .	3.82	3.59	3.73	4 28	3.74	4.75	4.03	4.51	3.96	4.24	4.36

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S OF THE DIFFERENT ARTICLES OF FEED CONSUMED DURING THE ABOVE EXPERIMENTS.

HAY.

[From Experiment Station, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C.,	8.30	166.00	–	–	1 : 9.5
	91.70	1,834.00	–	–	
	100.00	2,000.00			
of Dry Matter.					
	6.12	122.40	–	–	
lose,	30.19	603.80	350.20	58	
	2.55	51.00	23.46	46	
in (Nitrogenous tter),	9.75	195.00	111.15	57	
nous Extract Mat-	51.39	102.78	647.51	63	
	100.00	2,000.00	1,132.32		

consisted largely of Herd's-grass (*Phleum pratense*) op (*Agrostis vulgaris*), with a fair admixture of clover.

CORN FODDER.

[From the Experiment Station, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C.,	15 40	308.00	–	–	1 : 9.3
	84.60	1,692.00	–	–	
	100.00	2,000.00	–	–	
of Dry Matter.					
	4.22	84.40	–	–	
lose,	20.93	418.60	301.39	72	
	2.63	52.60	39.45	75	
in (Nitrogenous tter),	9.17	183.40	133 88	73	
nous Extract Mat-	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59		

ve corn fodder was raised under the same conditions, he soil and the fertilizers used are concerned, as the he silos.

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CORN ENSILAGE.

[From the Silos of the Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of
Moisture at 100° C.,	77.48	1,549.60	–	–
Dry Matter,	22 52	450.40	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	4.19	83.80	–	–
" Cellulose,	19.08	381.60	274.68	72
" Fat,	3.49	69.80	52.42	75
" Protein (Nitrogenous Matter),	7.82	156.40	114.17	73
Non-nitrogenous Extract Matter,	65.42	1,308.40	876.63	67
	100.00	2,000.00	1,317.90	

The above analysis represents the mean composition
ensilage obtained from the silos described in a previo
letin. The contents of the silos were fed in direct succ
beginning with the silo which had been filled slowly.
corn had been about six months in the silo when the
of the ensilage commenced.

CORN MEAL.

[Amherst Mill, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of
Moisture at 100° C.,	12.62	252.40	–	–
Dry Matter,	87.38	1,747.60	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	1.56	31.20	–	–
" Cellulose,	2.66	53.20	18.09	34
" Fat,	4.27	85.40	64.90	76
" Protein (Nitrogenous Matter),	11.43	228.60	194.31	85
Non-nitrogenous Extract Matter,	80.08	1,601.60	1,505.50	94
	100.00	2,000.00	1,782.80	

The average composition of the corn meal during the e
ments.

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WHEAT BRAN.

[Amherst Mill, 1885.]

93 per cent. passed through Mesh 144 to the square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C., . .	12.05	241.00	–	–	1 : 3.77
. . . . .	87.95	1,759.00	–	–	
	100.00	2,000.00	–	–	
s of Dry Matter.					
. . . . .	6.64	132.80	–	–	
lose, ...	11.49	229.80	45.96	20	
. . . . .	4.75	95.00	76.00	80	
in (Nitrogenous tter), ...	17.86	357.20	314.34	88	
nous Extract Mat-	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,384.46		

erage composition of the wheat bran during the ex-
.

LANE'S IMPROVED SUGAR BEET.

[From Experiment Station, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C., . .	83.57	1,671.4	–	–	1 : 5.86
. . . . .	16.43	328.6	–	–	
	100.00	2,000.0	–	–	
of Dry Matter.					
. . . . .	3.57	71.4	–	–	
lose, ...	5.27	105.4	105.4	100	
. . . . .	.83	16.6	16.6	100	
in (Nitrogenous atter), ...	17.44	348.8	261.6	75	
nous Extract Mat-	72.89	1,457.8	1,384.9	95	
	100.00	2,000.0	1,768.5		

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Summary of Amount of Digestible Matter contained in the pr described Feeding Periods.

PERIODS.	Total Amount of Food Consumed (in lbs.) during the Entire Period.	Total Amount of Dry Matter Consumed (in lbs.) during the Entire Period.	Digestible Portion of Dry Matter (in lbs.) Consumed during the Entire Period.*	Amount of Digestible Matter Consumed per Day (in lbs.).
I., Daisy and Mollie, .	477.00	433.00	267.40	14.86
II., " " " .	269.50	238.03	158.40	14.40
III., Daisy, . .	470.00	408.71	276.10	13.81
III., Mollie, . .	501.00	434.94	293.20	14.66
IV., Daisy and Mollie,	824.50	406.40	275 80	16.22
V., " " "	407.25	189.50	123.20	13.69
VI., " " "	466.00	185.40	124.60	15.58
VII., " " "	533.50	262.80	178.30	16.21
VIII., Daisy, . .	834.50	474.63	303.00	15.15
VIII., Mollie, . .	859.50	474.73	303.70	15.19
IX , Daisy, . .	878.00	408.63	267.20	14.06
IX., Mollie, . .	880.00	410.08	268.20	14.12
X., Daisy, . . .	600.00	201.93	135.90	11.33
X., Mollie, . . .	541.00	199.64	133.90	11.15
XI., Daisy, . .	545.75	184.35	118.70	10.79
XI., Mollie, . .	537.75	182 54	117.40	10.67
XII., Daisy and Mollie,	238.50	216.40	136.00	15.11

* The salines contained in these crops are not included.

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I. PERIOD (18 Days).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. . .	58.5	51.5	1.2	2.0	8.1	24.4
. . .	58.5	51.4	.5	1.7	5.0	38.7
. . .	360.	330.1	57 8	3.9	17.2	106.9
	477.0	433.0	59.5	7.6	30.3	170.0

Nutritive ratio, 1 : 8.2.

	Daisy.	Mollie.
dry matter consumed per day, in lbs., . .	24.06	24.06
ilk produced per day, ...	16 25	12.62

II. PERIOD (11 Days).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. . .	35.75	31.44	.7	1.2	4.9	14.9
. . .	35.75	31.27	2.8	1.0	3.1	23.5
. . .	110.00	100.87	17.7	1.2	5.6	32.7
. . .	88.00	74.45	11.2	1.5	5.0	31.4
	269.50	238.03	32.4	4.9	18.6	102 5

Nutritive ratio, 1 : 7.9.

	Daisy.	Mollie.
dry matter consumed per day, in lbs., . .	21.63	21.63
ilk produced per day, ...	15.36	11.86

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III. PERIOD (20 DAYS).

Daisy.

	Total Amount.	Dry Matter.	Digestible Portio			
			Cellulose.	Fat.	Protein.	
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Meal, ...	65.00	56.80	.5	1.8	5.5	
Shorts, ...	65.00	57.17	1.3	2.2	9.0	
Hay, ...	100.00	91.70	16.0	1.1	5.1	
Corn, ...	240.00	203.04	30.6	4.0	13.6	
	470.00	408.71	48.40	9.1	33.2	

Mollie.

Meal, ...	65.00	56.80	.5	1.8	5.5	
Shorts, ...	65.00	57.17	1.3	2.2	9.0	
Hay, ...	100.00	91.70	16.0	1.1	5.1	
Corn, ...	271.00	229.27	34.5	4.5	15.3	
	501.00	434.94	52.3	9.6	34.9	

	Daisy.
Nutritive ratio, ...	1 : 7.72
Amount of dry matter consumed per day, in lbs., .	20.43
Quarts of milk produced per day, ...	14.17

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IV. PERIOD (17 Days).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	55.25	48.60	.4	1.6	4.7	36.6
. .	55.25	48.59	1.1	1.8	7.6	23.0
. .	255.00	233.84	40.9	2.7	13.0	75.7
.	459.00	75.41	4.0	.6	9.9	52.2
	824.50	406.4	46.4	6.7	35.2	187.5

Nutritive ratio, 1 : 7.1.

	Daisy.	Mollie.
matter consumed per day, in lbs., . .	23.90	23.90
k produced per day, ...	14.2	11.16

V. PERIOD (9 Days).

Mollie and Daisy.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	29.25	25.73	.6	1.0	4.0	12.2
. .	135.00	123.80	21.7	1.5	6.9	40.1
. .	243.00	39.92	2.1	.3	5.2	27.6
	407.25	189.5	24.4	2.8	16.1	79.9

Nutritive ratio, 1 : 6.9.

	Daisy.	Mollie.
matter consumed per day, in lbs., . .	21.05	21.05
produced per day, ...	10.61	13.16

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VI. PERIOD (8 DAYS).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-ou M
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Hay, ...	120.00	110.04	19.3	1.3	6.1	
Shorts, ...	26.00	22.87	.5	.9	3.6	
Roots, ...	320.00	52.58	2.8	.4	6.9	
	466.00	185.44	22 6	2.6	16.6	

Nutritive ratio, 1 : 6.7.

	Daisy.
Amount of dry matter consumed per day, in lbs., . .	23.17
Quarts of milk produced per day, ...	13.31

VII. PERIOD (11 DAYS).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-ou Ma
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Meal, ...	35.75	31.24	.28	1.0	3.0	
Hay, ...	165.00	151.31	26.5	1 8	8.4	
Shorts, ...	35.75	31.44	.7	1.2	4.9	
Roots, ...	297.00	48.80	2.57	.4	6.4	
	533.50	262.8	30.0	4.4	22.7	

Nutritive ratio, 1 : 7.1.

	Daisy.
Amount of dry matter consumed per day, in lbs., . .	23.89
Quarts of milk produced per day, ...	14.22

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VIII. PERIOD (20 Days.)

Daisy.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	65.00	56.80	.5	1.8	5.5	42.8
. .	65.00	57.17	1.3	2.2	9.0	27.1
. .	292.00	267.76	46.9	3.1	14.9	86.7
. .	412.50	92.90	12.8	2.4	5.3	40.7
	834.50	474.63	61.5	9.5	34.7	197.3

Mollie.

. .	65.00	56.80	.5	1.8	5.5	42.8
. .	65.00	57.17	1.3	2.2	9.0	27.1
. .	284.00	260.43	45.6	3.1	14.5	84.3
. .	445.50	100.33	13.8	2.6	5.7	44.0
	859.50	474.73	61.2	9.7	34.7	198.1

	Daisy.	Mollie.
. . . . .	1 : 8.14	1 : 8.17
matter consumed per day, in lbs., .	23.73	23.73
produced per day, ...	12.8	11.2

IX. PERIOD (19 Days).

Daisy.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	61.75	53.96	.5	1.7	5.3	40.5
. .	61.75	54.31	1.2	2.1	8.5	25.7
. .	190.00	174.23	30.5	2.0	9.7	56.4
. .	564.50	126.13	17.3	3.3	7.2	55.3
	878.00	408.63	49.5	9.1	30.7	177.9

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Mollie.

	Total Amount.	Dry Matter.	Digestible Po		
			Cellulose.	Fat.	Protei
Meal, ...	61.75	53.96	.5	1.7	5.3
Shorts, ...	61.75	54.31	1.2	2.1	8.5
Hay, ...	190.00	174.23	30.5	2.0	9.7
Ensilage, ...	566.50	127.58	17.5	3.3	7.3
	880.00	410.08	49.7	9.1	30.8

	Daisy
Nutritive ratio, ...	1 : 8.1
Amount of dry matter consumed per day, in lbs., .	21.5
Quarts of milk produced per day, ...	11.

X. PERIOD (12 Days).

Daisy

	Total Amount.	Dry Matter.	Digestible Po		
			Cellulose.	Fat.	Protei
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Meal, ...	39.00	34.08	.3	1.1	3.3
Hay, ...	60.00	55.02	9.6	.6	3.1
Ensilage, ...	501.00	112.83	15.5	3.0	6.4
	600.00	201.93	25.4	4.7	12.8

Mollie.

Meal, ...	39 00	34.08	.3	1.1	3.3
Hay, ...	60.00	55.02	9.6	.6	3.1
Ensilage, ...	442.00	110.54	15.1	2.9	6.3
	541.00	199.64	25.0	4.6	12.7

	Daisy.
Nutritive ratio, ...	1 : 10.
Amount of dry matter consumed per day, in lbs., . .	16.
Quarts of milk produced per day, ...	9.

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XI. PERIOD (11 Days.)

Daisy.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	35.75	31.44	.7	1.2	4.9	15.9
. .	55.00	50.44	8.8	.6	2.8	16.3
. .	455.00	102.47	14.1	2.7	5.8	44.9
	545.75	184.35	23.6	4.5	13.5	77.1

Mollie.

. .	35.75	31.44	.7	1.2	4.9	15.9
. .	55.00	50.44	8.8	6	2.8	16.3
. .	447.00	100.66	13.8	2.6	5.7	44.1
	537.75	182.54	23.3	4.4	13 4	76.3

	Daisy.	Mollie.
, ...	1 : 8.29	1 : 8.25
matter consumed per day, in lbs., .	16.76	16.59
produced per day, ...	8.9	9.1

XII. PERIOD (9 Days).

Daisy and Mollie.

	Total Amount.	Dry Matter.	Digestible Portion.			
			Cellulose.	Fat.	Protein.	Non-nitrogenous Extract Matter.
.	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
. .	29.25	25.56	2.3	.8	2.5	19.2
. .	29.25	25.73	.6	1.0	4.0	12.2
. .	180.00	165.06	28.9	1.9	9.2	53.4
	238.50	216.4	31.8	3.7	15.7	84.8

Nutritive ratio, 1 : 8.

	Daisy.	Mollie.
matter consumed per day, in lbs., . .	24.04	24.04
lk produced per day, ...	8. 4	8.6

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Milk and Creamery Record from November 17, 1
to April 30, 1886.

	Quarts of Milk Produced.	Spaces of Cream from Milk.	Price allowed per Space
1885.			
November 17 to 30, . .	764	348	4 cts.
December 1 to 31, . .	862	409	4 "
1886.			
January 1 to 31, . . .	785	355	4 "
February 1 to 28, . . .	695	324	4 "
March 1 to 31, ...	772	339	4 "
April 1 to 30, ...	688	257	4 "
	4,566	2,032	–

November, 1885. 6.38 spaces of cream made 1 lb. butter, e
cents per pound.
December, " 6.50 spaces of cream made 1 lb. butter, equ
per pound.
January, 1886. 6.54 spaces of cream made 1 lb. butter, e
cents per pound.
February, " 6.65 spaces of cream made 1 lb. butter, e
cents per pound.
March, " 6.34 spaces of cream made 1 lb. butter, e
cents per pound.
April, " 6.13 spaces of cream made 1 lb. butter, e
cents per pound.

MILK ANALYSIS.

[Samples sent on for Examination.]

	1	2	3
Specific gravity, .	1.0375	1.032	1.0329
Temperature, C., .	19.°	20.°	17.5°
Solids, . . .	10.25 per ct.	13.67 per ct.	14.37 per ct
Fat, . . .	.42 "	4.15 "	4.87 "
Solids not fat, .	9.83 "	9.52 "	9.50 "

These samples are from the vicinity of Amherst.
skim milk.

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2. Fodder and Fodder Analyses.

plication of an intelligently devised system of tests, for the purpose of ascertaining the amount elative proportions of the essential proximate con- of our fodder articles, has rendered valuable ser- practical agriculture. The chemical analysis of ring their successive stages of growth has shown terations in their composition, as far as the *absolute* vegetable matter, as well as the *relative propor-* ne essential plant-constituents, are concerned. It red not less conspicuous the important influence soil in its varying state of fertility exerts on the nd the quality of the growth raised upon it. The erived from this source of information have stimu- iries concerning the safest modes of manuring, of g and of harvesting our different farm crops with ect of securing the most satisfactory returns under ircumstances.

er knowledge regarding the particular quality of s articles of fodder at our disposal improves our f supplementing them judiciously and thus econom- different kinds of farm live-stock, as well as for conditions and functions of the same kind. It fur- so, a safer basis for the explanation of the results in actual feeding experiments. To study the value or feeding effect of any of our fodder articles feeding experiments, without learning, as far as le, something more definite regarding its peculiar composition, deprives the results obtained largely general interest, for they are secured under ill- ircumstances. The chemical analysis of an article r is for these reasons considered the first step to render an intelligent interpretation of the results g trials possible. Actual feeding experiments have at *three groups of plant constituents*, namely, *nitro- on-nitrogenous* and *mineral constituents*, are *needed* sfully sustain animal life. No one or two of them, n support it for any length of time. In case the not contain digestible non-nitrogenous substances,

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the fat and a portion of the muscles of the animal will be consumed in the support of respiration be life terminates. In case digestible nitrogenous cons are excluded from the diet, the formation of new bl flesh from the food consumed ceases; for the animal according to our present state of information, is not of producing its principal constituents from anythi than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances from the plants; carnivorous animals indirectly, by on herbivorous animals. We feed, at present, ou stock too frequently, without a due consideration of t eral natural law of nutrition; to deal out our fodd only with mere reference to name, instead of ourselves more familiar with their composition an particular quality, deprives us even of the chance o ing an intelligent conclusion from our present sys feeding.

To compound the animal diet with reference to t ticular organization of the animal, its age and its fu is of no more importance than to select the fodd stances with reference to its special wants, as far absolute and relative quantity of the three essential of food constituents are concerned.

The peculiar character of our home-raised fodder is apt to conceal their special deficiency for the vari poses they are used for in general farm management. all contain the three essential food constituents, widely varying proportions; and they ought, there be supplemented in different directions to secure t economical value. To resort to more or less of t fodder article to meet the special wants, may meet t as far as an efficient support of the animal is concer it can only in exceptional cases be considered good ec

To satisfy the craving of the stomach and to feed tious food are both requirements of a healthy anim which, each in its own way, may be complied wit commercial fodder substances — as oil-cakes, mill brans, and our steadily-increasing supply of refuse m from breweries, starch works, glucose factories, et

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fitted to supplement our farm resources for stock they can serve in regard to animal growth and in a similar way as the commercial fertilizers in h of our farm crops, by supplementing our home resources. To feed an excess of food materials, potatoes, etc., which contain a large proportion of genous matter, as starch, sugar, digestible cellular , etc., means direct waste, for they are ejected by al, and do not even materially benefit the manure case of an excessive consumption of nitrogenous ts,— as oil-cakes, brans, gluten meal, etc., — a part pense is saved in an increased value of the manure yet scarcely enough to recommend that practice nerely exceptional cases. The aim, therefore, of omical stock-feeding must be to compound our odder materials in such a manner that the largest of each of the three above-stated groups of fodder s, which the animal is capable of assimilating, contained in its daily diet to meet the purpose for s kept.

pound the fodder rations of our farm stock, with to the special wants of each class of them, is an requirement for a satisfactory performance of their ; to supply these wants in an economical way con- financial success of the industry. From these and nsiderations it will be apparent that the develop- more rational, and thus more economical, system g farm live-stock requires the following kind of on : —

How much of each of the three essential groups onstituents is contained in the fodder we feed?

. How much of each of these essential food-con- is digestible under existing circumstances, and rectly available to the particular animal on trial?

How much of each of the three essential food- nts does each kind of animal require to secure the ts?

han twenty-five years have passed by since these have seriously engaged the attention of skilful nters. Sufficient valuable information has been

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secured in the course of time to encourage the use
adopted methods of observation, and to impart to
the conclusions arrived at, a just claim for a serious
eration on the part of practical agriculturalists.
that much needs still to be learned to meet the re
expectations of those engaged in the development of
economical system of feeding farm live-stock cannot
sidered a valid reason why we should not make an in
use of what we have learned.

The chemical analysis of a fodder article is ca
with a view to determine the quantity of each grou
constituents, which is considered an essential ingre
a complete food for the support of animal life. Ou
of analyzing articles of fodder are practically th
wherever this work is carried out intelligently. The
obtained are, therefore, applicable for the determini
comparative value wherever the identity of the mate
be established.

The actual results of the analysis are usually
under the following headings: —

1. Amount of moisture lost at 110° C., or 230°
amount of dry matter left behind.

2. Amount of mineral matter left behind after a
incineration of the material.

3. Amount of organic nitrogenous matter, co
called crude protein.

4. Amount of non-nitrogenous organic matter, e
of fat and of coarse cellulose substances.

The entire mass which any fodder substance leaves
after being heated at one hundred and ten degrees
grade thermometer, is called dry matter. An inc
dry substance in case of any plant or part of plan
same stage of growth, indicates usually a higher
value. To satisfy the cravings of the animal, a
quantity or bulk of coarse, dry matter becomes an
tant consideration in making up the fodder rations fo
ent classes of animals. In raising young stock for f
purposes, a liberal supply is also desirable, to
proper distention of the digestive organs, to mak
good feeders hereafter.

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enous substances, or protein matter, refer to several nitrogen-containing compounds, of plants in par- s albumin, fibrin, legumin, casein, etc., which are for the formation of blood and tissues. Those in animal matter, as meat refuse, are frequently d of a higher value than those in many plants.

trogenous substances include, in particular, starch, rganic acids, gums, fats and the digestible portion lular matter of the fodder. These substances are ransformed within the digestive organs into solu- ounds of a similar chemical character, and are thus to serve an identical physiological purpose. As ent investigations have shown a superior physio- lue of fat, — one of the non-nitrogenous constitu- wo and one-half times as much as starch, sugar, and resentatives of that group, its amount is separately The same course, for similar reasons, has of late pted with reference to certain forms of nitrogenous onstituents of fodder articles.

ubstances include all the various natural fats of the Most plants contain more than was assumed at an age of inquiry. As the fat is separated by means the statements in the analyses do not exactly ex- amount of fatty matter alone, but include more or ous substances, wax, etc., which are largely soluble and of a similar highly carbonaceous character. The fodder seems to serve, in case of judicious fodder mainly to increase the stock of fat in the animal nsumes the fodder.

ver the article has been tested by actual feeding nt under skilful observation, the amount of each group of food constituents which has been shown estible is reported in connection with the chemi- sis, under the heading *Digestible Portion*, per hun- ght or per ton. The higher or lower degree of ity of a fodder article exerts a decided influence on ive value. Different stages of growth affect the ligestibility of the various plant constituents. The ure is noticed in regard to different parts of plants, in case of different kinds of animals.

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More than two hundred fodder articles have thus fa
studied under varying circumstances, and most of ou
rent kinds of fodders have been tested in Europe and
where, in numerous well-conducted feeding experi
with a suitable selection of different kinds of farm
stock. This fact imparts to many of the results recor
sufficient importance to recommend them as a basis o
feeding trials, with feed stuffs raised in our clima
obtained in our home industries.

The last, but not least important, column of the staten
the chemical analysis — quite frequently found in the g
record of a fodder for a practical agricultural purpos
that of "Nutritive Ratio." These words are used to e
the numerical relation of its *digestible nitrogenous*
stances taken as one, as compared with the sum of its
ible non-nitrogenous organic substances, fat included.
information derived from that statement is very impo
for it means to express the summary of results secu
actual feeding trials under specified conditions, and wi
aid of the best-endorsed chemical modes to account f
constituents of the food before and after it has serv
the support of the animal on trial.

Experience has shown that different kinds of anim
well as the same kind at different ages and for di
functions, require a different proportion of the es
groups of food constituents to produce in each case th
results. A statement of the nutritive ratio of a
article — otherwise well adapted as an ingredient of a
diet in the case under consideration — indicates the di
in which the material has to be supplemented to eco
to a full extent its various constituents.

Practical trials with milch cows have demonstrate
they require for the highest production of a good mil
the maintenance of a healthy live weight, the most nut
food we are in the habit of giving to full-grown farm an
Careful examinations into the composition of an efficie
for milch cows have shown that it contains one p
digestible nitrogenous matter to from five to five and
parts of digestible non-nitrogenous organic matter.
consideration of these facts renders it but natural

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ensilage, which has a nutritive ratio of from 1 to 12, needs a liberal addition of substances like oil-eat bran, gluten meal, etc., which have a nutritive to from 2.5 to 4, to secure its full value as an of a daily diet in the dairy; or that good hay the beneficial effects of an addition of these valua-products than that of an inferior quality. The atio of hay may vary from 1 to 5.5 to from 1 to

ue of an article of fodder may be stated from two tandpoints, — that is, with reference to its cost in narket, and with reference to its nutritive feeding he market price may be expressed by a definite ach locality; it depends on demand and supply rket, and it is beyond the control of the indi-rmer. The nutritive value, or commonly called , of the article cannot be expressed by a definite aries with a more or less judicious application, and lso, to a considerable degree, on its adaptation ying circumstances. To secure the most satis-turns from feeding our home-raised fodder crops ortant a question as that of raising them in an l manner. The great progress which has been ng the past ten or twelve years in regard to the de of feeding plants ought to serve as an encour-o undertake the task of inquiring more systemati-the proper mode of feeding our farm live-stock in profitable way.

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CHICAGO GLUTEN MEAL.

[Bought at Springfield, Mass., 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents
Moisture at 100° C.,	8.95	179.00	–	–
Dry Matter,	91.05	1,821.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	.76	15.20	–	–
" Cellulose,	1.58	31.60	10.74	34
" Fat,	7.51	150.20	114.15	76
" Protein (Nitrogenous Matter),	30.81	616.20	523.77	85
Non-nitrogenous Extract Matter,	59.34	1,186.80	1,115.59	94
	100.00	2,000.00	1,764.25	–

WHEAT BRAN.

[From a mill in Amherst, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents
Moisture at 100° C.,	10.00	200.00	–	–
Dry Matter,	90.00	1,800.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	6.11	122.20	–	–
" Cellulose,	7 60	152.00	30.40	20
" Fat,	6.08	121.60	97.28	80
" Protein (Nitrogenous Matter),	18.63	372.60	327.89	88
Non-nitrogenous Extract Matter,	61.58	1,231.60	985.28	80
	100.00	2,000.00	1,440.85	–

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WHEAT MIDDLINGS.

[Sent on from Bolton, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
00° C., . .	10.55	211.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	
. . . . .	89.45	1,789.00			
	100.00	2,000.00			
of Dry Matter.					
. . . . .	2.49	49.80			
ose, . . .	1.40	28.00			
. . . . .	4 26	85.20			
n (Nitrogenous ter), . . .	19.21	384.20			
nous Extract	72.64	1,452.80			
	100.00	2,000.00			

osition is very fair, and its mechanical condition was not ory.

WHEAT MIDDLINGS.

[Sent from Barre, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
100° C., . .	9 85	197.00	Not determined by actual feeding tests.	Not determined by actual feeding tests.	
. . . . .	90.15	1,803.00			
	100.00	2,000.00			
of Dry Matter.					
. . . . .	2.53	50.60			
ose, . . .	2.75	55.00			
. . . . .	3.19	63.80			
n (Nitrogenous ter), . . .	17.23	344.60			
nous Extract	74.30	1,486.00			
	100.00	2,000.00			

rial contains less fat and nitrogenous matter than the pre- t not less than samples from the same mill may show at es.

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RYE BRAN.

[From Amherst Mill, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.
Moisture at 100° C.,	8.18	163.60	–	–
Dry Matter,	91.82	1,836.40	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	3.43	68.60	–	–
" Cellulose,	3.46	69.20	6.23	9.0
" Fat,	3.03	60.60	34.85	57.5
" Protein (Nitrogenous Matter),	16.52	330.40	218.06	66.0
Non-nitrogenous Extract Matter,	73.56	1,471.20	1,096.04	74.5
	100.00	2,000.00	1,355.18	–

The material has a fair composition. Recent observations by c observers seem to indicate that it ought not to take the place of bran in the dairy.

HOMINY MEAL.

[Sent on from Berlin, Mass.]

51.64 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	10.70	214.00	–	–
Dry Matter,	89.30	1,786.00	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	2.82	56.40	–	–
" Cellulose,	3.69	73.80	25.09	34
" Fat,	10.88	217.60	165.38	76
" Protein (Nitrogenous Matter),	11.88	237.60	201.96	85
Non-nitrogenous Extract Matter,	70.73	1,414.60	1,329.72	94
	100.00	2,000.00	1,722 15	–

The composition is that of a good article of its kind.

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CORN COB MEAL (CORN AND COB).

[Collected at a mill near Amherst, Mass., 1886.]

	Per cent.
00° C.,	9.45
	90.55
	100.00

Analysis of Dry Matter.

	Per cent.
	1.64
ose,	6.32
	5.19
n (Nitrogenous Matter),	9.85
ous Extract Matter,	77.00
	100.00

position of this article depends somewhat on the ight of cob and kernels; the former may vary from r cent. in current varieties. See article "On dif- eties of corn, etc." (Secretary's Report of Massa- ate Board of Agriculture, 1879–80, pages 222 to

YELLOW SWEET CORN.

[Raised on the fields of the Experiment Station, 1885.]

n five to seven inches in length, having eight rows Weight of an average ear, 70.16 grammes; weight 57.40 grammes, or 81.8 per cent.; weight of cob, mes, or 18.2 per cent. Average weight of a ker- grammes.

	Per cent.
00° C.,	10.90
	89.10
	100.00

Analysis of Dry Matter.

	Per cent.
	2.16
se,	2.58
	4.25
(Nitrogenous Matter),	12.61
ous Extract Matter,	78.40
	100.00

le is somewhat deficient in fat, as compared with ican" or Crosby's.

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"SELF-HUSKING" CORN.

[Experiment Station, 1885.]

Ears eight rows, eight to ten inches long. Kern reddish or brownish red color. Weight of an avers 142.7 grammes; consisting of 88.08 per cent. kern 11.92 per cent. cob. Average weight of a single ker grammes.

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

SWEET APPLE POMACE.

[Sent on for examination from Prescott, Mass., 1885.]

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

CORN REFUSE FROM STARCH FACTORY.

[Sent on from New Bedford, Mass.]

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

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ove-named material, which furnished the sample sent amination, had been bought at a corn-starch factory Island, N. Y., for feeding cattle. Forty tons had led at New Bedford, at $8 per ton of forty bushels. ubts had been expressed in regard to its fitness as a nilch cows.

mple we received was apparently in a fair state of ion, and consisted mainly of a soft, yellowish-white terspersed with coarse fragments of the skin of the he entire mass, in an air-dried state, was quite soft and nd of a peculiar vegetable, yet not offensive odor.

omposition of the vegetable matter contained in the that of a valuable ingredient for the compounding of diet for various kinds of farm live-stock, and in some similar to that of the refuse grain from breweries. The ectionable feature of the fresh factory refuse consists esence of a large amount of moisture, and its liability a rapid and serious deterioration in consequence of a keeping, in particular during the warmer seasons of . Two modes of treatment for the preservation of rticles like the one here under discussion suggest es in this connection, — the silo system and the drying s. The above-described corn-starch factory refuse, in state, could command a price from $16 to $18 per ton arkets.

ness of this class of refuse material from glucose and ctories, as well as from brewers' grains, as an ingredi- daily fodder ration for all kinds of farm live-stock, cow included, is quite generally conceded, provided in a fair state of preservation. Excessive and exclu- ing of many fodder articles is an objectionable prac- s applies as much to corn ensilage, roots and apples, as aste products of the factories above enumerated.

dder articles of a perishable character deserve the ttention of farmers, for they are apt to become objec- sooner or later, if carelessly kept. In an advanced ermentation they are decidedly objectionable, for vari- ns; they may become even poisonous in consequence iability to turn into hot-beds of a dangerous, parasitic

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growth. Musty corn meal, oil cakes, etc., are known to been the direct cause of the death of cows.

"THE CONCENTRATED FEED."

[Sent on by South Deerfield Farmers' Club, South Deerfield, Mass.]

97.52 per cent. passed through Mesh 144 to the square inch.

Moisture at 100° C.,	
Crude Ash,	
" Cellulose,	
" Fat,	
" Protein (Nitrogenous Matter),	
Non-nitrogenous Extract Matter,	

Analysis of Dry Matter.

Crude Ash,	
" Cellulose,	
" Fat,	
" Protein (Nitrogenous Matter),	
Non-nitrogenous Extract Matter,	

The material was received in a bag marked "The Co trated Feed Company, Boston, Mass." A circular, fro agent at South Deerfield, contained a statement of an an of the article, which, as far as essential points are conce does not materially differ from our own, above reported.

The material was of a good, mechanical condition, and sisted evidently of a mixture of several ingredients; a them was noticeable common salt. An actual test show presence of 7.4 per cent. of chlorine, which indicate presence of from 11 to 12 per cent of common salt. inquiry it was learned that "The Concentrated Feed" s $8 per one hundred weight, — a most remarkable price f article of fodder without any stated guaranty of its vario gredients, nor any statement of its rate of digestibility some specified conditions. The selling price of the seems to be based largely on the merits of the invention compound. It would be no difficult task to compound our most reputed concentrated feed-stuffs, even without

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ition of common salt, an article which would conform omposition claimed by the manufacturer of "The Con- d Feed," and at the same time could be sold with a mpensation to the agent, even in remote localities, at a e per ton than "The Concentrated Feed" sells for per dred pounds.

remarks in previous pages it must be apparent that analysis of a fodder article, without any further reliable tion concerning its source and its special character, afe basis for a decision regarding its particular value ing purposes. The practice of buying compound feed- the general market, without a sufficient actual knowl- garding the kind or the character of their varied ingredi- ght to be decidedly discouraged; for the farmer who that course leaves his best interests to mere chance. commercial compound feed-stuffs without some more knowledge of the articles which constitute them can out little useful information for future operation beyond on to be less credulous hereafter.

ALYSES OF FEED-STUFFS WITH REFERENCE TO THE FERTILIZING CONSTITUENTS THEY CONTAIN.

omposition of the various articles of food used in farm exerts a decided influence on the manurial value of nal excretions resulting from their use in the diet of t kinds of farm live-stock. The more potash, phos- acid, and in particular nitrogen, a fodder ingredient , the more valuable will be, under otherwise corre- g circumstances, the manurial residue left behind, after rved its purpose as a constituent of the food consumed. e financial success in most farm managements depends siderable degree on the amount, the character and the the manurial refuse material secured in connection with ial farm industry carried on, it needs no further argu- prove that the relations which exist between the com- of the fodder and the value of the manure resulting, s the careful consideration of the farmer, when devis-

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ing an efficient and at the same time an economical diet
live stock.

The question whether one or the other fodder mixtu
prove ultimately, under otherwise corresponding circums
the cheapest one, can only be answered intelligentl
both the original cost of the feed consumed and the valu
manurial residue subsequently obtained are duly consid

The close relation, which quite necessarily exists i
farm managements between the system of cultivating th
and the keeping of farm live-stock for farm work, for th
and for the supply of food for the general market, im
the barn-yard manure a special if not a controlling imp
as a valuable manurial resource. The barn-yard manur
to remain in a judicious system of mixed farming, — not
main reliance of the farmer for plant food, but also the
est manure at his disposal. The objections raised a
against a liberal use of barn-yard manure ought not to
its higher cost of production, when compared with othe
rial substances in our market. The name "barn-yard m
is, however, too frequently used without any particu
crimination with reference to all kinds of manurial ref
tained in connection with stock feeding and stock
which are frequently of widely differing composition.
proximate even fairly the comparative value of two
obtained on different farms remains a hopeless task, as
a more definite information regarding the following p
wanting: —

1. The character of the fodder consumed.

2. The kind, the age and the function of the anima
served for its production.

3. The nature and the quantity of the material which
for the absorption of the animal excretions.

4. The care bestowed upon collecting and preserv
entire liquid and solid excretions.

Assuming for our present purpose, in both instance
tical conditions, as far as the kind of animal, the mode
lecting and the care of keeping the manure are concer
will be apparent that the relative value of the two kinds
yard manure stand essentially in a direct relation to the

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n, potash, phosphoric acid, etc., which was contained
l consumed.

lowing analyses of fodder articles are obtained at the
of the Station, from fair samples which came under
vation.

of similar analyses of fodder crops, based mainly
verage analyses of E. Wolff, are published in the
report of the Secretary of the Massachusetts Board
lture for 1885, page 146.

1. CORN COBS.

lt of four current varieties of corn raised in Hampden and Hampshire counties, Mass.]

	Per cent.
100° C.,	10.00
organic matter (17 cents per pound),	0.54
	1.03
	0.20
,	0.01
de,	0.03
oxide,	0.06
xide (4¼ cents per pound),	0.68
le,	0.04
acid (6 cents per pound),	0.08
er 2,000 lbs.,	$2.52

2. CORN MEAL.

[From mill at Amherst, Mass.]

	Per cent.
100° C.,	10.00
organic matter (17 cents per pound),	1.86
	1.50
	0.005
,	0.015
de,	0.027
oxide,	0.197
xide (4¼ cents per pound),	0.45
le,	0.064
acid (6 cents per pound),	0.77
er 2,000 lbs.,	$7.62

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3. VILMORIN (SUGAR BEET). 4. GLOBE MAN

	Pounds
	3
Moisture at 100° C.,	85.99
Dry matter,	14.01
Nitrogen (17 cents per pound),	.29
Crude ash,	.62
Potassium oxide (4¼ cents per pound),	.18
Sodium oxide,	.18
Calcium oxide,	.06
Magnesium oxide,	.04
Phosphoric acid (6 cents per pound),	.03
Ferric oxide,	.01
Insoluble matter,	.10
Valuation per 2,000 lbs.,	$1.18

Relative Percentage of Soluble Essential Constituents in One H of Ash (3-4).

	3
Potassium oxide,	36.648
Sodium oxide,	35.795
Calcium oxide,	11.932
Magnesium oxide,	7.103
Phosphoric acid,	6.534
Ferric oxide,	1.988
	100.000

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WHOLE APPLES.

RHODE ISLAND GREENINGS. 6. SWEET APPLES.

	Pounds per Hundred.	
	5	6
0° C.,	84.650	75.170
	15.350	24.830
ents per pound),	.113	.156
	.327	.501
de (4¼ cents per pound),	.122	.269
	.013	.042
	.023	.044
ide,	.025	.029
	.001	.005
d (6 cents per pound),	.008	.011
er,	.002	.004
2,000 lbs.,	$0 49	$0 60

APPLE POMACES.

RHODE ISLAND GREENINGS. 8. BALDWIN APPLE.

	Pounds per Hundred.	
	7	8
0° C.,	78.220	82.780
	21.780	17.220
ents per pound),	.241	.213
	.237	.306
le (4¼ cents per pound),	.119	.150
	.032	.020
	.042	.032
ide,	.027	.028
	.008	.008
d (6 cents per pound),	.017	.018
er,	.009	.008
2,000 lbs.,	$0 92	$0 87

osition of the apples which served for the above pomaces has been described in the Third Annual e Experiment Station, pages 86, 87.

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9. WHEAT MEAL.

[From a mill in Amherst, Mass.]

Moisture at 100° C.,	
Nitrogen in organic matter (17 cents per pound),	
Crude ash,	
Magnesium oxide,	
Calcium oxide,	
Potassium oxide (4¼ cents per pound),	
Sodium oxide,	
Phosphoric acid (6 cents per pound),	
Valuation per 2,000 lbs.,	

10. WHEAT MIDDLINGS.

[From a mill in Amherst, Mass.]

Moisture at 100° C.,	
Nitrogen in organic matter (17 cents per pound),	
Crude ash,	
Magnesium oxide,	
Potassium oxide (4¼ cents per pound),	
Calcium oxide,	
Sodium oxide,	
Phosphoric acid (6 cents per pound),	
Valuation per 2,000 lbs,	

11, 12. WHEAT BRAN.

[From a mill in Amherst, Mass.]

Moisture at 100° C.,	
Phosphoric acid (6 cents per pound),	
Magnesium oxide,	
Sodium oxide,	
Potassium oxide (4¼ cents per pound),	
Nitrogen in organic matter (17 cents per pound),	
Insoluble matter,	
Valuation per 2,000 lbs.,	$

The above analyses refer to the quality of bran at the Station.

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13. PROVENDER.

	Per cent.
°° C.,	10.48
d (6 cents per pound),	0.78
ide,	0.05
	C.18
	0.22
e (4¼ cents per pound),	0.37
ganic matter (17 cents per pound),	2.10
er,	0.29
2,000 lbs.,	$8 40

provender consisted of 100 lbs. of wheat bran, ats and 450 lbs. of corn-meal.

14. GLUTEN MEAL.

[Bought at Springfield, Mass.]

	Per cent.
° C.,	9.00
ganic matter (17 cents per pound),	5 44
	0 70
	0.058
ide,	0.034
e (4¼ cents per pound),	0.06
	0.021
l (6 cents per pound),	0.45
,000 lbs.,	$19 05

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FIELD EXPERIMENTS.

[Field A.]

1. Fodder Corn raised upon underdrained and Lands, partly Fertilized with Single Ar Plant Food, partly without the use of any Matter.

In the First Annual Report of the Station has bee the underdraining of a piece of land, one and one-t acre in size, subdivided into eleven plats. The fi serve for an examination into the actions of variou substances on the growth of corn, and the influen character of the drainage water discharged from t under a different treatment of the soil. It had bee several years previous to the establishment of the E Station in 1882 as a meadow for the production of h ing the spring of 1883 it was planted with corn (l variety), for fodder corn, without the use of any The same course of planting and cultivation was during 1884 (changing from the Longfellow to the Cl of corn) for the purpose of exhausting the soil, as f ticable, for the cultivation of corn with any prospec nerative returns.

The corn crop raised in 1884 upon these eleve unmanured land left no doubt about their exhausted as far as a further successful cultivation of corn was for the entire yield of corn fodder from this piece o and one-tenth of an acre in size, amounted to 5,04 with a moisture of thirty per cent.

These results encouraged the beginning of a spec into the chemical and physical condition of our soil *its relation to the production of the corn crop is co* well as into *its particular power to retain*, in a high degree, *various articles of plant food;* i. e., its qual prevent their passage into the drainage water.

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ends in view, the following course was decided
ried out during the succeeding season (1885).
ield (A) was prepared, May 12, in a similar man-
nting of corn as in preceding years (see Second
t, page 81).

. .	Thrown out of the experiment.
. .	Twenty-five pounds of sodium nitrate (= to 4 lbs. of nitrogen).
. .	Nothing.
. .	Thirty pounds of dried blood (= to 4 lbs. of nitrogen).
. .	Nothing.
. .	Twenty-five pounds of ammonium sulphate (= to 5 lbs. of nitrogen).
. .	Nothing.
. .	Fifty pounds of dissolved bone-black (= 8.5 lbs. of available phosphoric acid).
. .	Nothing.
. .	Twenty-five pounds of muriate of potash (= from 12 to 13 lbs potassium oxide).
. .	48½ pounds potash-magnesia sulphate (= to 12-13 lbs. potassium oxide).

on the entire field was cut September 5, and the
ch plat stacked by itself in the field for drying;
October 10, with the following results: —

1885.

Amount of Dry Corn Fodder Obtained.	Fertilizer Applied.
480 lbs.	25 lbs. of sodium nitrate (= 4 lbs. of nitrogen).
310 "	Nothing.
350 "	30 lbs of dried blood (= 4 lbs. of nitrogen).
300 "	Nothing.
360 "	25 lbs. of ammonium sulphate (= 5 lbs. nitrogen).
-	Fallow.
280 "	50 lbs. of dissolved bone-black (= 8.5 lbs. available phosphoric acid).
250 "	Nothing.
945 "	25 lbs. of muriate of potash (= from 12 to 13 lbs. potassium oxide).
845 "	48½ lbs. potash-magnesia sulphate (= from 12 to 13 lbs. of potassium oxide).

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Comparing these results with those obtained in the
year, where the produce of the various plats was p
of a corresponding weight (458 lbs. each), it wa
that the application of potash compounds alone, m
potash leading (see Plats No. 9 and 10), had exerted
effect on the quantity and the quality of the corn fodd
increasing the previous annual yield not less than
dred per cent. above that of the preceding year (188

The amount of corn fodder raised on Plat No.
received nitrate of soda, had exceeded but slightly
that of the previous season; while the application
ammonium sulphate and phosphoric acid had not pre
considerable falling off. The yield of corn fodder of
and unfertilized plats was practically the same in
stances.

In sight of these facts, it seemed but justifiable to
that a deficiency of the soil in available potash had c
in our case, more than that of any other essential
plant food, — the final yield of the crop.

As the cultivation of grasses and fodder corn a
manurial resources of the soil in a similar directio
stracting approximately one part of phosphoric aci
parts of potash, it is but a natural result that a s
originally did not contain much more of available po
of available phosphoric acid must become unproducti
the latter is exhausted. In case circumstances nec
direct succession of these two crops, it is well to
that fact, and to provide against a failure by applyi
soil liberally, in particular, potash compounds in som
other. Muriate of potash deserves recommendation.

To verify the above conclusion, the experiment wa
ued during the past season (1886), with the sole
tion of increasing on each fertilized plat the parti
tilizing ingredients to twice the amount used in the
year.

The plats were thoroughly plowed and harrowed
1886. The fertilizers were sown broadcast in each
slightly harrowed in before planting the corn, in rows
and 22 (Clark's variety). The rows were three f
inches apart. The seeds were dropped from twelve to

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rt and six to eight kernels in a place. The young
eared uniformly and healthy looking in all plats
They turned, however, into a pale green color by
vith the exception of those on Plats 9 and 10. The
e still of a dark green color September 11, when
crop was cut and stooked in the field. The corn
n Plats 1 to 8 inclusive had reached at the end of
a height of from two to four feet, and showed only
there a partially filled ear; it was badly dried up
lthy looking when cut. The plants grown upon
d 10 had reached a height of from five to eight feet;
and leaves were still succulent when cut, and the
y well formed throughout the plats, but small, and
s scarcely beginning to glaze.

ght of the corn fodder raised upon each plat was
d October 23, when the crop was housed. The sub-
abulated statement contains the results of the ex-
. The weights of the corn fodder are stated with
to the same state of moisture (from 45 to 50 per
in the preceding year, to allow a comparison of the

1886.

	Amount of Dry Corn Fodder Obtained.	Fertilizer Applied.
.	430 lbs.	50 lbs. of sodium nitrate (=7-8 lbs. of nitrogen).
.	250 "	Nothing.
.	310 "	60 lbs. of dried blood (=7-8 lbs. of nitrogen).
.	250 "	Nothing.
.	280 "	50 lbs. of ammonia sulphate (=10 lbs. of nitrogen).
.	–	Fallow.
.	255 "	100 lbs. of dissolved bone-black (=17 lbs. available phosphoric acid).
.	195 "	Nothing.
.	840 "	50 lbs. of muriate of potash (=25 lbs. of potassium oxide).
.	895 "	97 lbs. of potash-magnesia sulphate (=25 lbs of potassium oxide).

esults, compared with those of the previous year, show
ng off in yield in all plats, notwithstanding a decided

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increase of the various single manurial substances a
Plats 1, 3, 5, 7, 9 and 10. The yield of the fertilize
3, 5, 7 during the last season (1886) is less than t
unfertilized plats in 1885. The good service of po
pounds in our case is still remarkable.

The experiment will be continued, with some mod
during the coming season.

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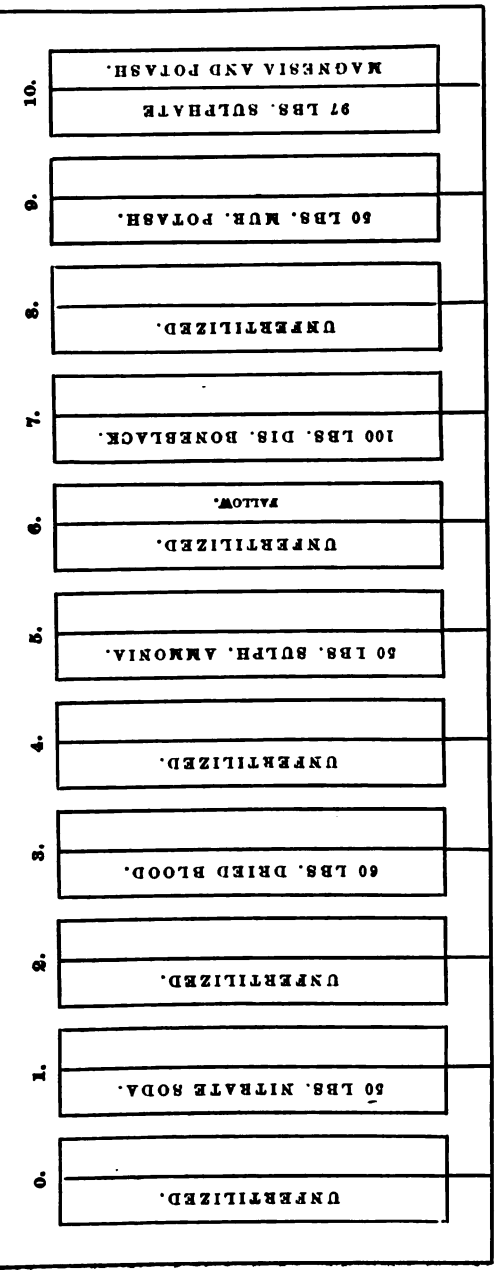

Corn Plats with Drainage System. Scale, 4 rods to 1 inch.

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2. Fodder Corn and Corn Ensilage.

The last annual report on the work of the Exper tion contains upon pages 52 and 53 a record of ob concerning the gradual increase of vegetable matt fodder corn during its successive stages of growth. of tests carried out with plants taken from our demonstrated the fact that the vegetable matter in t of corn on trial (Clark) had increased from fif hundred per cent. in actual weight, between the t first appearance of the tassel and the beginning of t of the kernels. It was found that the same variet raised under fairly corresponding circumstances, as general character of the soil and the mode of culti concerned, contained in one hundred weight parts a of the first appearance of the tassel from twelve weight parts of dry vegetable matter, and from eig eighty-eight parts of water; whilst at the time of the of the glazing of the kernels the former was notice from twenty-three to twenty-eight weight parts, and from seventy-seven to seventy-two. These resul investigation left no doubt about the fact that fodder corn at the time of the beginning of the the kernels contained nearly twice as much vegeta per ton weight of corn as at the time of the appeara tassels.

This feature in the change of the composition of corn during its growth is not an exceptional on changes are noticed in all our farm plants. Our ob in this direction were reported for the purpose of some more definite numerical values for the consid our practical farmers. As long as the vital ene annual plant is still essentially spent in the increase as a rule but a comparatively small amount of valuab compounds, as starch, sugar, etc., accumulates withi lar tissue. The comparative feeding value of the of fodder plants, or any particular part of such plant be measured by its size, but by the quantity of valuab nitrogenous and non-nitrogenous constituents stored cellular system. The larger or smaller amount of d

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left behind from a given weight of samples of the
of a fodder plant of a corresponding stage of growth
the majority of cases their respective higher or
omical value for feeding purposes. Agricultural
or this reason, usually begin their examination of
ts with a test for the determination of the amount
etable matter left behind, when carefully brought to
weight at a temperature not exceeding 110° C.

er varieties of corn are not necessarily the more
inds for the production of fodder; on the contrary,
e more judicious, on general principles, to doubt
ior fitness for that purpose until otherwise proved.
ment applies, in particular, to some varieties re-
sferred to our section of the country; for they seem
an exceptionally rich soil to yield the best results
presented to be capable of producing. Raised in a
derate resources of plant food, little of the latter
over, after the production of their tall stocks and
es, to assist in the formation of valuable organic
, as sugar, starch, fat, nitrogenous matter, etc., to
entire plant. The same mode of reasoning applies
ng of exceptionally large-sized roots, potatoes, etc.;
sually but partly matured, and thus of a watery,
taste.

eral character of the climate and the physical and
ondition of the soil control the local adaptation of a
ccessful cultivation. Extremes of season and one-
es of manuring are apt to modify the growth of a
thereby alter its composition. To learn how to
nherent tendency of a plant to a rank growth, in the
a fairer chance for a complete maturity of the final
ost desirable information to secure; for success in
on insures not unfrequently a superior pecuniary re-
careful study of the special characteristics of the
ial under the influence of existing local resources of
of the prevailing local features of the weather during
g season alone, can furnish a safe guide for the
of the desired end.

ermination of the relative feeding value of different
the same kind of plants raised under different cir-

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cumstances is always carried out with plants of a cor
ing stage of growth. Progress in the growth of plan
their composition in regard to the quantity of vegetabl
which they contain in a given weight; it also changes
terially the absolute and relative proportion of their
food constituents, *i. e.* their nutritive value.

The amount of vegetable matter in a given weight
fodder corn cut at the beginning of the glazing of the
is known to be not only nearly twice as large as compa
that contained in an equal weight of green fodder corn
just showing the tassels, it is also known to be p
pound more nutritious, for it contains more starc
sugar, more of valuable nitrogenous matter, etc.

Considering the previously stated views correct,
our silos during last autumn with fodder corn, which
reached the point where the kernels began to gla
expecting to secure an ensilage of superior feeding valu
results of our experiments in that direction have b
satisfactory, and may be summed up as follows: —

1. The course adopted for the production of cor
for the silo secures the largest amount of valuabl
which a given area of land planted with fodder corn
duce under corresponding circumstances, as far as
season are concerned.

2. The ensilage of a more matured fodder corn has
feeding value, pound for pound, than that cut at an earl
of growth.

3. The more matured fodder corn, on account of
texture, is less crushed by close packing, and cons
better resists the peculiar influences which tend to d
and ultimately destroy the contents of the silo.

As a more detailed description of the products of
may not be without some interest to our readers
period of the season, we publish below the essentia
our results, beginning with an abstract from our la
report, which relates briefly the course pursued in fi
silo.

The corn fodder, when cut for the silo, September
began to acquire a slightly yellowish tint along the o
the field, yet was still green and succulent in the interi

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were soft, their contents somewhat milky, and their beginning to glaze.

ilage.— Two silos of the same size, five by four-side measure, and eleven feet deep, were used for ent. In both instances the corn was cut into one and one-quarter to one and one-half inches in ere, however, filled in a different way.

1 was loosely filled, September 4, to about two-height, and the mass merely levelled without tread- It was left in this condition without covering nber 7, at 8 o'clock A. M. At this time it had eighteen to twenty-four inches; the odor of acetic slightly perceptible, and the pieces of cornstalk, eet to the taste, showed an acid reaction to the litmus).

.	Temperature	at	12	inches	depth,	147°,	145°,	147° F.
.	"	"	12	"	"	141°,	145°,	145° F.
.	"	"	24	"	"	136.5° F.		
.	"	"	30	"	"	114° F.		
.	"	"	36	"	"	107° F.		

nperature remained practically at a standstill, the more fresh-cut corn was resumed, and the silo et loosely filled, September 8. A maximum reg-rmometer was buried in the mass at a depth of two e surface, and light boards loosely laid over the

8 A.M Temperature at 12 inches depth, 129 , 127° F.

had now settled eighteen inches.

.	Temperature	at	12	inches	depth,	127°,	129°,	131° F.
.	"	"	12	"	"	122°,	132° F.	

had settled from twenty-four to thirty inches. ture remained practically the same; the mass was vered with tarred paper and tight-fitting boards, ently, on September 12, pressed down with twenty- of sand. This silo contained about eight tons of odder.

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The temperature observations above recorded were r
different parts of the silo; they show that it is quite
to secure a desirable uniform temperature within the
all parts of the silo, at the same depth and at the same

Silo No. 2 was filled to a depth of from eight to n
as fast as the cut corn could be supplied and trampe
As soon as the amount of corn assigned for that silo (9
was filled in, the surface was carefully covered wit
paper and tight-fitting boards, in the same manner a
of the first silo, and at once pressed down with tw
barrels of sand. A maximum registering thermom
safely buried at a depth of about two feet in the
record the highest temperature which the latter wou
during the time of keeping the silo closed.

The silo had been closed about six months when
The highest temperature recorded by the thermomete
at a depth of two feet below the surface of the ensil
closing the silo, was 116.5° F.

A layer of eighteen inches in thickness on the top,
six to eight inches along the sides, was of dark color
for fodder. It was removed until no mould could b
on the leaves and stem parts; the ears of the corn w
preserved. The main bulk of the ensilage was of a
yellow color, and showed a decided acid reaction to
paper. The odor was at first that of organic matte
disintegrating under the exclusion of air, but chang
after the opening of the silo into that of acetic acid (
The free organic acids contained in one hundred wei
of the fresh ensilage (directly after the opening of
required 1.309 parts of sodium hydroxide for their ne
tion, which is equal to 1.96 per cent of acetic acid.
quantity of fresh ensilage contained 0.0374 parts of ac
monia. No starch could be detected in the stems an
whilst an abundance of it was found in the ears.

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CORN ENSILAGE.

[Taken from Silo No. 1, March 23, 1886]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C., . . .	78.05	1,561.00	–	–	1 : 12.2
. . . . .	21.95	439.00	–	–	
	100.00	2,000.00	–	–	
of Dry Matter.					
. . . . .	3.16	63.20	–	–	
lose, ...	20.48	409.60	294.91	72	
. . . . .	3.84	76.80	57.60	75	
in (Nitrogenous tter), ...	7.37	147.40	107.60	73	
nous Extract	65.15	1,303.00	873.01	67	
	100.00	2,000.00	1,333.12	–	

. 2 was opened seven months after being filled. A t six inches in thickness had to be removed from the e sides of the contents of the silo to reach an accept- er for cows. The highest temperature registered by ometer since its introduction into the silo at a depth t at the time of closing was 97.8° F.

CORN ENSILAGE.

[Taken from Silo No. 2, April 25, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
100° C., . . .	76.90	1,538.00	–	–	1 : 10.4
. . . . .	23.10	462 00	–	–	
	100.00	2,000.00	–	–	
of Dry Matter.					
. . . . .	5 22	104.40	–	–	
lose, ...	17.67	353.40	254.45	72	
. . . . .	3.15	63.00	47.25	75	
in (Nitrogenous tter, ...	8.27	165.40	120.74	73	
nous Extract	65.69	1,313.80	880.25	67	
	100.00	2,000.00	1,302.69	–	

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The main body of the ensilage was in fine cond yellowish green color, somewhat lighter than in silo 1 had a slightly acid smell and taste. To neutraliz organic acids contained in one hundred weight part ensilage, collected at the opening of the silo, requi parts of sodium hydroxide, which is equal to 1.95 p acetic acid. The amount of ensilage contained 0.02 actual ammonia.

A comparison of these observations with those ma nection with the contents of No. 1 shows that in ou direct filling and closing of the silo produced the be The contents of the silo filled at once with cut co and subsequently carefully closed up, had suffered le alteration in various directions than those that h through a previous heating process, in consequence o exposure to atmospheric agencies. The records of mometers, the chemical analyses of the ensilage from and the general character of both kinds of ensilage c above conclusion. Adding to these statements th stance that our cows decidedly preferred the ensilage No. 2, we feel that we can recommend the course p filling that silo. As the free acids, acetic and lactic, ensilage, however carefully prepared, steadily increas opening of the silo, as long as unchanged sacch amylaceous constituents (sugar and starch) are pre very important that the access of air should be limit as practicable. The decision in regard to the best si silo should be largely controlled by the possible ra sumption. The feeding value of the contents of carefully packed silo is apt to be most seriously im consequence of a subsequent prolonged exposure t Three to four weeks' exposure altered the character o lage seriously, as far as its acidity was concerned. T of the change depends, under corresponding circu largely on the surrounding temperature. It is far le the winter months than in April or May.

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of Corn and Cob before and after their Treatment in a Silo.

ob; cured naturally in the field. 2. Whole corn and cob; from silo. 3. Cut corn and cob; from silo.]

	Per Cent.		
	1	2	3
0° C.,	10.71	25.50	50.27
	89.29	74.50	49.73
	100.00	100.00	100.00
nalyses of Dry Matter.			
	2.16	1.43	1.35
se,	5.39	8.32	8.50
	5.27	8.66	7.84
(Nitrogenous Matter),	12.18	10.56	6.63
ous Extract Matter,	75.00	71.03	75.68
	100.00	100.00	100.00

rial which served for the above analyses was sent purpose during the month of September, 1886, with g statement: The different samples were taken from t of corn eleven months ago. The crop was cut ars began to glaze. No. 1, whole ears, was re- n the stalks and dried in the usual way on the o. 2, whole ears, was buried at the same time in ut six feet below the surface of the cut material, sted of the cut stalks and cut ears; No. 3 consisted cut ears of corn taken from the main bulk of corn the same time when sample No. 2 was removed for tion, about eleven months after the filling of that samples were collected for the purpose of ascertain- racter and the degree of change which the ear of dergoes by converting it into ensilage, either whole nt into pieces. A comparison of the analytical vs, what might be expected, that cut ears of corn suffer a more serious alteration in their composi- hole ears.

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Analyses of Rowen.

[1. Sun-dried in the field. 2. After being in a silo eleven mont

	1
	1
Moisture at 100° C.,	19.
Dry Matter,	80.
	100.
Analysis of Dry Matter.	
Crude Ash,	8.
" Cellulose,	29.
" Fat,	4.
" Protein (Nitrogenous Matter),	14.
Non-nitrogenous Extract Matter,	41.
	100.

These analyses point in the same direction as the
ones. The reduction of nitrogenous matter as com
that of the non-nitrogenous extract matter is most
yet this circumstance does not represent the enti
organic matter. The decrease in crude cellulose a
crease in crude fat both confirm that statement. To
more exactness the loss of organic matter in cases
under consideration, requires a more definite kno
garding the amount of dry matter contained in the fr
and of the average moisture of the various layers of
the silo. None of our ordinary modes of preserving
without the liability of losses; it remains in most i
matter of degree, depending quite largely on circ
beyond the control of the farmer. Succulent plants
likely to suffer seriously in the ordinary drying proc
is for this reason that the silo system deserves, in
a careful consideration for the efficient preservatio
crops.

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ENSILAGE MADE FROM APPLE POMACE.

[Amherst Mill.]

	Per cent.
00° C.,	85.33
	14.67

Analysis of Dry Matter.

	4.21
ose,	22.18
	7.36
n (Nitrogenous Matter),	8.22
ous Extract Matter,	58.03
	100.00

ace which served for the preparation of the apple as taken from a cider-mill near Amherst towards of October, 1885, and consisted of the clear press mixture of different kinds of apples.

ks, of a capacity of from fifty to sixty gallons each, for the experiment. They were painted inside with r varnish to render them air and water tight. The s stamped down solid, and subsequently covered per, which was held down by a layer of sand sev- in thickness, and some large stones. The casks, were kept in a corner on the barn-floor until May when they were opened to examine their contents. ial was found throughout apparently as fresh as up; neither mouldy, rotten, or even discolored on It had a pleasant fruit-like acid odor and taste, ed but traces of ammonia compounds. One hun- of the fresh apple ensilage required 0.744 parts of droxide for the neutralization of its free organic h prove thus to be less than in either kind of corn The ensilage of apple pomace is highly relished nd swine, and is, if not superior, at least equal, ound, in feeding value to the apple pomace, which its production. The nitrogenous constituents had t the expense of the saccharine constituents; the een destroyed at a higher rate by fermentation than

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3. Influence of Fertilizers on the Quantity Quality of some Prominent Fodder Cr

[Field B.]

The land selected for the experiment had been use eral years previous, for the production of hay. At ning of the season of 1883 it had been ploughed a with corn, without the addition of any fertilizer. Th sisted of a good sandy loam, and was, in conseque previous treatment, in a suitably impoverished co respond to the application of fertilizers.

The entire field, consisting at that time of one and of an acre, was subdivided into plats, each one-tenth in size. Every alternate plat was fertilized at the hundred pounds of ground, rendered bones, and tw pounds of muriate of potash, per acre. The fer applied a few days before seeding, and slightly under.

The experiment in 1884 comprised four standar i. e., Orchard grass (*Dactylis glomerata*), Meadow fe *tuca pratense*), Timothy (*Phleum pratense*) and Red *tis vulgaris*), besides two Millets, Hungarian grass *Germanicum*) and Pearl millet (*Penicillaria spicata* variety of corn, Clark. (See sketch of Field B, 18

The plats Nos. 11, 13, 15, 19 and 21 were fertil Nos. 12, 14, 16, 18 and 20 received no manurial any description.

In the case of the grasses and millets, each plat subdivided into two, and each half seeded down wi tinct kind of grass seed as follows: —

Plat 11 (fertilized), ...	Orchard Grass (no Meadow Fescue (s
Plat 12 (unfertilized), ...	Orchard Grass (no Meadow Fescue (s
Plat 13 (fertilized), ...	Hungarian Grass Pearl Millet (south
Plat 14 (unfertilized), ...	Hungarian Grass Pearl Millet (south

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lized), ...	Timothy (north side), Redtop (south side).
rtilized), ...	Timothy (north side), Redtop (south side).
lized), ...	Corn (Clark).
rtilized), ...	Corn (Clark).
lized), ...	Corn (Clark).
rtilized), ...	Corn (Clark)
lized), ...	Corn (Clark).

RESULTS OF EXPERIMENTS WITH CORN.

Analysis of Green Fodder Corn.

		Plat 17. (Fertilized.)	Plat 18. (Unfertilized.)
1884.			
the beginning g,	Moisture at 100° C., .	87.62	85.15
	Dry Vegetable Matter,	12.38	14.85
nels in Milk,	Moisture at 100° C., .	72.27	78.77
	Dry Vegetable Matter,	27.73	21.23

ats, $\frac{1}{10}$ of an acre each, . .	Plat 17, 4,340 lbs. Plat 19, 3,096 lbs.	Total yield, 7,436 lbs.
Plats, $\frac{1}{10}$ of an acre each, .	Plat 18, 2,460 lbs. Plat 20, 2,556 lbs.	Total yield, 5,016 lbs.

ilized Plats, per acre, ...	37,180 lbs.
ertilized Plats, per acre, ...	25,080 "
ce in yield, ...	12,100 lbs.

tion of Dry Vegetable Matter in Corn Fodder (fertilized).

. . . . .	3.16 parts.
ose, ...	24.32 "
. . . . .	2.89 "
n, ...	9.64 "
ous Extract Matter, ...	59.99 "

the year 1885, plats Nos. 17, 18, 19, 20 and 21 n, as in previous years, for the cultivation of corn. raised upon the fertilized plats Nos. 17, 19 and 21 n part for ensilage; that obtained from the unferti- Nos. 18 and 20 was sold as dry fodder corn; both cut at the same time to compare results.

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The entire crop upon all plats was cut Sept. 4, 18
dry corn fodder secured from the fertilized plats av
tons per acre, and that from the unfertilized plats in
nection yielded $3\frac{1}{10}$ tons for the same area. The
plat No. 13 produced 1,870 pounds of dried millet,
pounds ($9\frac{1}{3}$ tons) per acre; and the unfertilized pl
(for three succeeding years without manure) produ
pounds of air-dried crops, or 10,500 pounds ($5\frac{1}{4}$ to
corresponding area.

The plats 11, 12, 15 and 16 (Field B), which had be
down broadcast, during the month of September, 1
several varieties of grasses for the purpose of stud
individual nutritive character at different successive
growth, became soon infested with all kinds of plants
circumstance could not otherwise than quite seriously
with our object, it was thought best to replough these
to seed down again *each variety* of *grass*, *in drills*.
vation of grasses in drills, two feet apart, was ado
much success June 22, 1885. A frequent use of the
aided by the hoe and the weeding by hand, has ena
secure a suitable material for examination during las
1886.

No material changes have been made of late in t
arrangement and mode of treatment of the plats in
beyond the addition of an area of forty-three feet in l
of a corresponding width of the existing plats on the w
each individual plat. This addition makes the prese
of these plats 175 feet; they are each 33 feet wide (
of Field B in 1886). The same varieties of grass
corn (Clark) were cultivated. The latter was also p
place of two varieties of millets during the precedin
plats 13 and 14. The corn was planted, as in previ
in drills three feet three inches apart; the seed was
from six to eight in a place, at a distance of from
fourteen inches apart, May 17, 1886. Plats 13, 17,
were fertilized with ground bones and potash, as in
years, while plats 14, 18 and 20 received no manurial
any description. The growth of the corn on fertilize
fertilized plats presented throughout the season a simil
ance, as has been noticed and described on previous

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ception of the fertilized plat 13 and the unfertilized ch yielded a larger return than any other of the plats rresponding treatment. These two plats had been m the cultivation of corn in 1883 to that of millet 1885. They were evidently left in a better condi- raising of fodder corn in 1886 than the remaining had been used for the production of fodder corn, interruption since 1883.

on all plats was cut September 9 and 10, when the an to glaze. The produce of the fertilized plats and 21 was turned into corn ensilage, and that of ized plats 14, 18 and 20 was stooked in the field er 12, when it was housed in common with the dried obtained from the under-drained plats of Field A, n the previous pages.

f Green Fodder Corn obtained on Fertilized Plats per Acre.

.	Green fodder corn for silo,			35,410 lbs.,	or 17.75	tons.
.	"	"	"	27,310 "	13.65	"
.	"	"	"	28,290 "	14.15	"

f Dry Fodder Corn obtained on Unfertilized Plats per Acre.

Plat 14.	Dry fodder corn,			6,200 lbs.,	or 3.1	tons.
Plat 18.	"	"		4,500 "	2.25	"
Plat 20.	"	"		3,000 "	1.5	"

ses upon plats 11, 12, 15 and 16 looked well in the he difference in their general appearance, between d plat 11 and the unfertilized plat 16, and the un- lat 12 and the fertilized plat 15, was less marked case of the corn; it became, however, quite striking on advanced. The growth upon the fertilized plats case denser, taller and of a deeper color at the time for hay than for rowen. The Orchard grass was in four to five days earlier (June 7) than the Meadow une 12). The Timothy (Herd's grass) bloomed bout one week earlier than the Redtop, July 5. The plats 11 and 12 were cut July 5, and those on plats July 11.

zed plat 11 yielded 560 lbs. of hay (Orchard and Fescue).
ilized plat 12 yielded 510 lbs. of hay (Orchard and Fescue).
zed plat 15 yielded 690 lbs. of hay (Timothy and Redtop).
ilized plat 16 yielded 550 lbs. of hay (Timothy and Redtop).

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From this statement it will be noticed that —

Plat 11	yielded	hay	at the	rate of	2.1	tons	per ac
Plat 12	"	"	"	"	1.9	"	"
Plat 15	"	"	"	"	2.59	"	"
Plat 16	"	"	"	"	2.06	"	"

The result is remarkable, considering that the row were two feet apart, leaving thus one-half of the a land unoccupied by the crop. The second growt was not less satisfactory than the first; it was cut 13 and 14.

The fertilized plat 11 yielded 225 lbs. of rowen (Orchard an
The unfertilized plat 12 yielded 185 lbs. of rowen (Orchard
The fertilized plat 15 yielded 230 lbs. of rowen (Timothy an
The unfertilized plat 16 yielded 175 lbs. of rowen (Timothy

It may be seen from this that —

Plat 11	yielded	rowen	at the	rate of	.84	tons	per a
Plat 12	"	"	"	"	.69	"	"
Plat 15	"	"	"	"	.86	"	"
Plat 16	"	"	"	"	.65	"	"

The cultivation of grasses in drills renders a satisf vesting of the crop quite troublesome, on account of t of a large admixture of soil in the dried crop unde modes of management.

Samples of the various kinds of grasses on trial collected at successive stages of their growth to asce respective relative nutritive value. The results analytical-chemical investigations will be published the work has sufficiently advanced to admit of an presentation.

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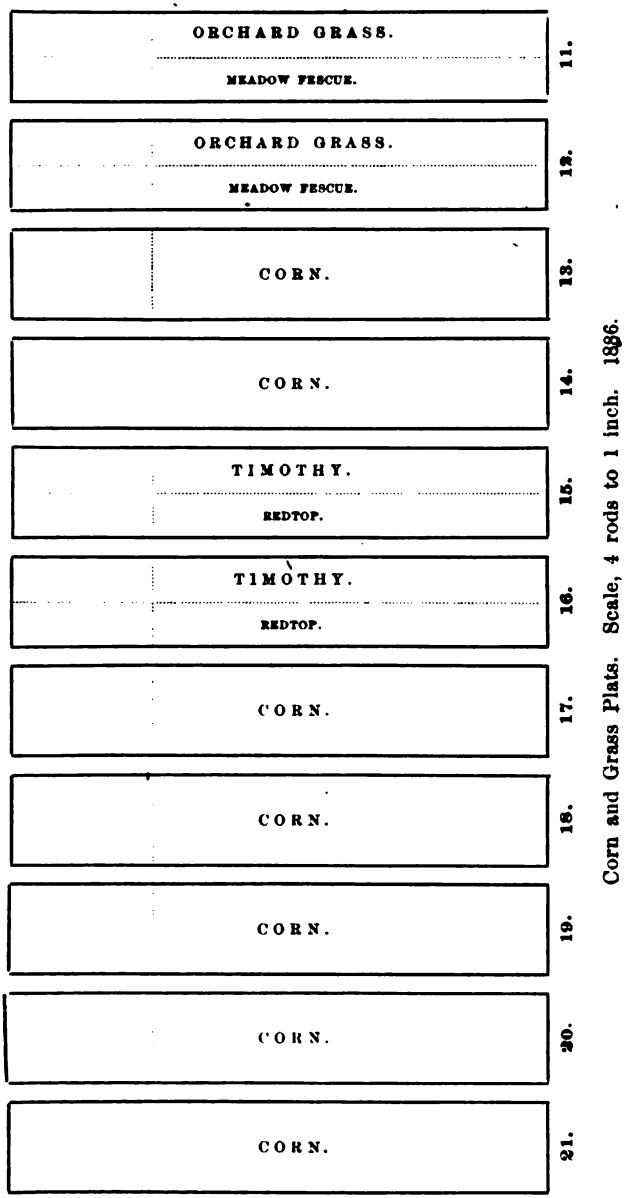

Corn and Grass Plats. Scale, 4 rods to 1 inch. 1886.

tted line indicates the addition made to the original are of one-tenth of one
ch plat during the fall of 1885.

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4. Experiments with the Cultivation of Fodde furnish a Continuous Supply of Suitable G der for Dairy Stock during the Summer

[Field C.]

The experiment was planned chiefly for the purpo taining the area required for the cultivation of each of ing crops, oats, vetch, serradella and Southern cow serving in the stated succession as green fodder for of a definite number of milch cows, from the beginnin the middle of September. These crops, which have b described more or less in detail in previous reports, w to attain upon our grounds a suitable state of growth purposes at such succeeding periods of the season a to meet the requirements of the object in view. Th each crop began when it had reached the stage of blo it was discontinued when it approached its matur coarse, dry fodder, consisting mainly of hay of o previous year, was fed with the green fodder, to action on the digestive organs.

The practice of raising a greater variety of valu like those previously stated, for green fodder d serious consideration of farmers engaged in the dair for it secures a liberal supply of healthy, nutritious time when hay becomes scarce and costly, and wh be still a wasteful practice to feed an imperfectly ma fodder-corn. The frequently limited area of land munerative production of grasses, and the not less exhausted condition of a large proportion of natur makes it but judicious to consider seriously the m promise not only to increase, but also to cheapen, t of the dairy. A liberal introduction of reputed f into farm operations has everywhere in various dire moted the success of agricultural industry. The fie for the raising of oats, vetch and Southern cow-pe feet long and 90 feet wide; it was divided into parts, each 30 feet wide and 240 feet long. Th covered an area 85 feet long and 56 feet wide.

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ed of a good loam, and was in a fair state of cultivation. rtilizers used consisted of six hundred pounds of fine- l bones and one hundred and fifty pounds of muriate of per acre. The different crops were cultivated in drills eet three inches apart; they proved, without exception, ss.

. — The variety raised in this connection was secured in cinity. Its particular name is somewhat uncertain; it quite tall, and forms thickly-leaved stems; the grain good average size and weight. The oats were sown ; the young plants appeared May 12; they began to July 5. The feeding of the green oats commenced that d was continued for about two weeks, until July 20, he plants turned yellowish. Forty pounds were fed per each cow.

Composition of Green Fodder Oats.

	1886.		
	July 5.	July 12.	July 20.
	Per cent.	Per cent.	Per cent.
at 100° C., ...	78.61	71.18	66.04
ter, ...	21.39	28.82	33.96

composition of our variety of oats at the time of feeding inferred from the following analysis of a sample raised same ground in 1885 and published in the last annual —

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HAY OF OATS.

[From Plats of Station, cut while in Milk, July 9, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	9.55	191.00	–
Dry Matter,	90.45	1,809.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	6.08	121.60	–
" Cellulose,	34.32	686.40	–
" Fat,	2.69	53.80	24.75
" Protein (Nitrogenous Matter),	10.89	217.80	124.15
Non-nitrogenous Extract Matter,	46.02	920.40	920.40
	100.00	2,000.00	1,069 30

Vetch (Vicia sativa). — The seed was imported to
same variety of vetch which had been tried here i
years. It was sown May 14, and made its first
May 19. The growth was kept clean by frequent
cultivator. The latter was first used May 24, when
plants had reached a height of two inches. The fi
blooming were noticed July 6. The feeding of the
commenced July 20, and was continued until
Twenty-five pounds were used in the daily diet pe
second crop was cut September 13. The vetch yie
and valuable growth, yet seems best adapted for g
when raised as a mixed crop with oats, barley or
green vetch is not as much relished at the beginnin
cows as the mixed crop.

Composition of Green Vetch.

[July 19, 1886.]

Moisture at 100° C., ...
Dry Matter, ...

The subsequent copies of two analyses of vetch ra
own grounds in previous years may convey some m
idea regarding the composition of this reputed fodde

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VETCH (HAY).

(VICIA SATIVA; VARIETY, ANGUSTIFOLIA)

[I. Collected from Experimental Plats, Aug. 15, 1883, in bloom.]

I.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
e at 100° C.,	8.35	167.00	–	–	
tter,	91 65	1,833.00	–	–	
	100.00	2,000.00	–	–	
lysis of Dry Matter.					
Ash,	7.97	159.40	–	–	1 : 4.02
Cellulose,	30.68	613.60	331.34	54	
Fat,	2.30	46.00	27.60	60	
Protein (Nitrogenous Matter),	15.76	315.20	239.55	76	
rogenous Extract er,	43.29	865.80	562.77	65	
	100.00	2,000.00	1,161.26	–	

VETCH (HAY).

. Collected from Experimental Plats, Sept. 3, 1883, when fully matured.]

II.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent of Digestibility of Constituents.	Nutritive Ratio.
e at 100° C.,	9.45	189.00	–	–	
tter,	90.55	1,811.00	–	–	
	100.00	2,000.00	–	–	
lysis of Dry Matter.					
Ash,	8.50	170.00	–	–	1 : 4.09
Cellulose,	30.05	601.00	270.45	45	
Fat,	2.69	53.80	32.28	60	
Protein (Nitrogenous Matter),	14.42	288.40	204 76	71	
rogenous Extract er,	44.34	886.80	487.74	55	
	100.00	2,000.00	995.23	–	

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Serradella (Ornithopus sativus, Brot.). — The s
cultural value of this plant has been pointed out in
report. The successful cultivation upon the fields
tion in preceding years encouraged its trial as a g
in connection with the experiment under discussion.
was planted May 12; the young plants showed
May 20; they commenced blooming July 13. The
green serradella began August 3 and was discontinu
of that month. At first twenty-five pounds, and s
from thirty to thirty-five pounds, formed part of th
of each cow on trial. The green serradella is hig
by the dairy cows, and has evidently a very benefici
on the yield of milk.

Composition of Green Serradella.

[August 4, 1886.]

Moisture at 100° C., ...
Dry Matter, ...

The subsequent two analyses of samples raised h
vious years are republished in this connection t
general character of this valuable fodder plant.

SERRADELLA (HAY).

(ORNITHOPUS SATIVUS, BROT.)

[I. Obtained from plats of the Station when blooming, Aug. 1

I.

	Percentage Composition.	Constituents (in lbs). In a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C., . .	7.20	144.00	–
Dry Matter, ...	92.80	1,856.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash, ...	5.87	117.40	–
" Cellulose, ...	24.37	487.40	–
" Fat, ...	2.37	47.40	28.44
" Protein (Nitrogenous Matter), ...	17.85	357.00	224.91
Non-nitrogenous Extract Matter, ...	49.54	990.80	990.80
	100.00	2,000.00	1,244.15

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SERRADELLA (HAY).

II. From plats of Station, collected Sept. 3, 1883, when fully matured.]

II.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
re at 100° C.,	8.70	174.00	–	–	1 : 5.47
atter,	91.30	1,826.00	–	–	
	100.00	2,000.00	–	–	
lysis of Dry Matter.					
Ash,	6.46	129.20	–	–	
Cellulose,	25.14	502.80	236.32	47	
Fat,	2.91	58.20	29.10	50	
Protein (Nitrogenous Matter),	15.26	305.20	183.12	60	
trogenous Extract er,	50.23	1,004.60	693.17	69	
	100.00	2,000.00	1,141.71	–	

thern Cow-pea (Dolichos?); variety, Whippoorwill Pea. e seeds were obtained of J. Wolfenden, provision dealer, wbern, N. C., who kindly furnished us with seeds in pre- years. The general characteristics of this valuable South- dder-plant have been pointed out in the Second Annual t of the Experiment Station, 1884, pages 91–93. The vas sown May 14; the young plants were first noticed 25; they made slow progress until July 15, when they to develop more rapidly; they reached, August 14, a t of from one and one-half to two feet, and formed a dense h of deep green vines. The green cow-pea was fed from 4th of August to the 15th of September, 1886, beginning 24 pounds per day and increasing gradually the amount pounds in the daily diet. Several cows served in the ex- ents; the daily fodder rations per head were compounded following manner: —

Composition of Green Cow-pea.

[August 24, 1886.]

	Per cent.
ure at 100° C.,	83.00
latter,	17.00

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COW-PEA (HAY).

(VARIETY: WHIPPOORWILL.)

[From Experimental Plats of Station; collected Aug. 1, 18

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	9.65	193.00	–
Dry Matter,	90.35	1,807.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	10.46	209.20	–
" Cellulose,	22.36	447.20	210.18
" Fat,	3.87	77.40	45.67
" Protein (Nitrogenous Matter),	16.95	339.00	203.40
Non-nitrogenous Extract Matter,	46.36	927.20	639.77
	100.00	2,000.00	1,099.02

The feeding of green cow-pea ceased on account
supply. The vines grow until late in the season;
our autumn weather extremely well.

Feed in Pounds per Day.

	1886.			
	June 24 to July 5.	July 6 to July 20.	July 21 to Aug. 3.	Aug. 4 to Aug. 24.
Corn Meal,	3.25	3.25	3.25	3.25
Wheat Bran,	3.25	3.25	3.25	3.25
English Hay,	20.00	–	–	–
Hay of Oats (1885),	–	10.00	10.00	10.00
Green Oats,	–	40.00	–	–
Green Vetch,	–	–	25.00	–
Green Serradella,	–	–	–	35.00
Green Cow-pea,	–	–	–	–

As our supply of hay of oats (1885) gave out
ginning of September, a small amount of English ha
stituted. The feeding of green fodder crops with
of a coarse, dry fodder has a good effect on the g

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of the animal. Hay of oats is best chopped for that pur-
A temporary increase of bran, oilcakes, gluten meal
odder articles of a similar composition instead of corn
suggests itself in this connection as an improvement on
ily fodder rations during a first trial.

ing our mode of cultivation into consideration, it seems
ble to cultivate for the supply of one cow, for the period
e above stated, an area of from 5,000 to 5,500 square feet
s, and from 7,000 to 7,500 square feet each of vetch, ser-
a and cow-pea. In case oats and vetch are to be raised
ixed crop, 12,000 square feet might be the limit. The
ature too rapidly to answer for more than two weeks as a
fodder.

field (C) turned to account for the purpose described
is in a first-class condition for the cultivation of winter
, as far as time of seeding, clean cultivation and special
ulation of plant food is concerned. Vetch, serradella
ow-pea belong to the valuable family of *Leguminosæ;*
like the clover, enrich the soil in the interest of grain
A variety of wheat occupies at present the area.

analysis of the hay of oats used in our feeding experi-
as been stated on a previous page; that of English hay
here: —

HAY.

[From Station Fields, 1885.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
e at 100° C.,	8.30	166.00	–	–	
tter,	91.70	1,834.00	–	–	
	100.00	2,000.00	–	–	
ysis of Dry Matter.					
sh,	6.12	122.40	–	–	
ellulose,	30.19	603.80	350.20	58	1 : 9.5
at,	2.55	51.00	23.46	46	
rotein (Nitrogenous Matter,	9.75	195.00	111.15	57	
ogenous Extract r,	51.39	1,027.80	647.51	63	
	100.00	2,000.00	1,132.32	–	

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5. Experiments with Potatoes.

(Var.: Beauty of Hebron.)

The experiments carried on in this connection are conducted for the following purpose: —

First, To study the special effect, if any, of n potash and of sulphate of potash on the quantity a of potatoes raised by their aid as the principal potas plant food.

Second, To ascertain the effect of planting whol and half potatoes, on the yield of the crop.

Third, To inquire into the causes of the pro scabby potatoes.

The first two objects of inquiry have received since 1884; the last-mentioned one has been added t during the past year, at the special request of the Harvest Club. The same piece of land has been use beginning of our field work (1884), as far as the first lines of observation are concerned; whilst a separat chosen for studying the behavior of "*scabby* pot "*seed* potatoes." As a short description of the cour in previous years cannot fail to assist in a due appr the results of the past season, a few essential circum in this connection republished from previous annual

A. — *Experiments with High-grade German Potash Ground Bones as Fertilizers.*

1884. — Three plats, each one-fifth of an acre in chosen for the experiment. The land had been fo grass, and contained quite a number of old apple t majority of the latter were removed, and the turf broken up before manuring, during the spring of 18

Plat 1 (west end) received one hundred and twe of ground rendered bones and thirty pounds of muri ash (equal to from twenty-six to twenty-seven poun phoric acid, four to four and one-half pounds of nit fifteen to sixteen pounds of potassium oxide).

Plat 2 received no manure of any kind.

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at 3 (east end) received one hundred and twenty pounds round rendered bones, and fifty-eight pounds of double nate of potash and magnesia (equal to from twenty-six to ty-seven pounds of phosphoric acid, four to four and one- pounds of nitrogen, fifteen to sixteen pounds of potassium , and five to six pounds of magnesium oxide).

e fertilizers were applied broadcast, and harrowed under e planting. The potatoes were planted in rows, three part and fourteen inches distant in the drills, during the week in May, 1884. The crop was kept clean from weeds timely use of the cultivator.

an additional feature of the experiment, one-half of each was planted with medium-sized whole potatoes; the other half potatoes obtained from a similar size.

e vines produced by whole potatoes showed a more vigor- rowth during the main part of the season than those by of a potato. The entire field looked promising until rds the middle of August, when with the appearance of the t the life of the stems and leaves prematurely terminated. e crop was harvested on the 9th and 10th of September. results farther on.)

Analyses of Potatoes (1884).

e hundred parts of air-dried fresh potatoes contained: —

	From Plat 1.	From Plat 2.	From Plat 3.
egetable Matter, ...	19.39	23.30	21.52
. . . . .	80.61	76.70	78.48
	100.00	100.00	100.00

vell-matured potato contains on an average, approximately, y-five per cent. of solid matter. The unmatured potatoes evidently more advanced in growth, whilst those manured nuriate of potash were least advanced in that direction.

e latter, on the other hand, had the smoothest skins, and *almost entirely free from scab, which seriously disfigured from Plats 2 and 3.*

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1885. — The arrangement of the field, the mode of ma
and the variety of the potatoes raised was the same a
preceding season. The same three plats served for the
ment, each one-fifth of an acre in size; the potatoe
planted April 27. Plat No. 1 received, as fertilizer,
pounds of muriate of potash and one hundred and thirty
of steamed fine-ground bones; Plat No. 2 received no fer
Plat No. 3 was fertilized with fifty-eight pounds of
magnesia sulphate and one hundred and twenty pou
fine-ground bones. The rows were three feet three
apart, and the seed potatoes dropped from eighteen to t
four inches in the row. One-half of each plat was plant
medium-sized whole potatoes; one-half with half a pots
spot. The seed potatoes used had been carefully selecte
our own crop raised during the preceding season on th
plats.

The young crop was hoed June 9. The difference
plats was quite marked July 24; plat (No. 1) with
ate of potash had the largest foliage and looked darke
than the remainder; that with potash sulphate (No. 3)
next best. A *blight on the leaves*, which showed itself
the first week of August, prematurely terminated the
ment; the vines upon all plats died soon after. The cr
harvested August 26. (See results farther on.)

The potatoes from all the plats suffered severely from s

As the increase of vegetable matter in the young plan
cates the progress of their growth, it was decided to dete
from time to time, the actual amount of vegetable matt
given weight of the more advanced tubers, by carefully
ling the water present, a t a temperature of from 100° to

A well-matured potato contains, as has been stated
on an average twenty-five per cent. of solid matter.

The subsequent statements are the results of our ex
tion.

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Determination of Solids in Potatoes.

JULY 24.

	From Plat No. 1.	From Plat No. 2.	From Plat No. 3.
re at 100° C., ...	81.44	79.49	79.39
. . . . .	18.56	20.51	20.61
	100.00	100.00	100.00
AUGUST 5.			
re at 100° C., ...	80.96	81.04	79.36
. . . . .	19.04	18.96	20.64
	100.00	100.00	100.00
AUGUST 27.			
re at 100° C., ...	79.85	80.60	80.61
. . . . .	20.15	19.40	19.39
	100.00	100.00	100.00

exceptionally large proportion of small potatoes obtained ticular from Plats Nos. 2 and 3, as well as the low per-ge of solids in the potatoes tested, prove the premature ation of a healthful condition of the entire crop. The l growth of the tubers came apparently to a standstill after the first examination for solids had been made 24, etc.). The results seemed to indicate a connection en "blight" and "scab"; and left scarcely any doubt the circumstance, that either the one or the other, or both , had contributed directly or indirectly towards the partial of the crop for the two succeeding seasons.

as decided, in sight of these facts, to continue the experi-in 1886 upon the same field, with some modifications, to ain, if possible, whether the main influence regarding sults in our past observation had to be ascribed to atmos-agencies, or to the condition of the soil and to the fer-applied or to the quality of the seed potato used.

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1886. — The same field was used. The land was pared by plowing and harrowing April 27, and su fertilized the same as in previous years. Plat broadcast, as before, a mixture of muriate of p fine-ground bones. Plat 2 received, as before, no f any description. Plat 3 was again manured broad sulphate of potash and fine-ground bones. The chang ing the character of the fertilizer applied, consiste nearly twice the amount of potash salts, muriate of sulphate of potash for the same area in case of Plat The increase in potash compounds was made to efficacy as a preventative of scab. A second importa from our previous practice consisted in securing fi seed potatoes, — in particular, *free* from scab. variety — Beauty of Hebron — was obtained for tha from Vermont; it was as fair an article as could b The system of planting and cultivating was the s previous years. The potatoes were planted upon all 5, 1886; each plat had fourteen rows, with hills apart in each direction. The young plants appeare the vines coming from whole potatoes, however, soo heavier and taller than those coming from half p peculiarity in their growth which remained noticeab the entire season. All the vines were in full blosso they began to turn yellowish and to dry up July 30. on the entire field was dried up August 8. This chang to appear most marked first on the vines from w potatoes. The entire crop was harvested August 28.

The experiment of the past season has been a serio as far as the *quality* of the potatoes raised on any of plats is concerned. The entire crop, with scarcely a tion, was badly disfigured by scab; the potatoes wer family use, and had to be sold at a low price for stoc

Neither a liberal use of our own mixture of commerc rial substances, rich in potash compounds, nor the se a fair quality of seed potatoes from another source, ha our results as compared with those of the previous seas successful raising of a *superior* potato from *scabby* s toes upon another field of the Experiment Station, w be described farther on in these pages, shows that t

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c peculiarities of the last summer season cannot have d the above-reported failure. In sight of these circum- es it seems but natural to incline to the conclusion that peculiar condition of the soil upon the lands occupied by experiment has to be considered as the real seat of our le. The work will be continued until a more positive can be offered.

e subsequent tabular statement regarding certain features e potato crops raised for three successive years upon the experimental plats here under discussion are not without est when considered in connection with the preceding rks.

1884.

PLAT I.

ED POTATO.	Fertilizer Applied.	Yield of Potatoes upon One-fifth of an Acre, in Pounds.		
		Large.	*Small.*	*Total.*
Potato, .	120 lbs. ground bones and 30 lbs. muriate of potash.	1,085	460	1,545
lf a Potato, .		1,140	335	1,485
		2,225	795	3,030

PLAT II.

		Large.	*Small.*	*Total.*
Potato, .	Not fertilized.	830	280	1,110
lf a Potato, .		850	250	1,100
		1,680	530	2,210

PLAT III.

		Large.	*Small.*	*Total.*
Potato, .	120 lbs of bones and 58 lbs. potash-magnesia sulphate.	1,120	342	1,462
lf a Potato, .		930	105	1,035
		2,050	447	2,497

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1885.

PLAT I.

SEED POTATO.	Fertilizer Applied.	Yield of Potatoes of an Acre, i	
		Large.	*Sma*
Whole Potato, .	120 lbs. ground bones and 30 lbs. muriate of potash.	705	35
One-half a Potato, .		695	27
		1,400	62

PLAT II.

		Large.	*Sma*
Whole Potato, .	Not fertilized.	335	35
One-half a Potato, .		255	27
		590	62

PLAT III.

		Large.	*Sma*
Whole Potato, .	120 lbs. of bones and 58 lbs. potash-magnesia sulphate.	605	49
One-half a Potato, .		540	58
		1,145	1,07

1886.

PLAT I.

SEED POTATO.	Fertilizer Applied.	Yield of Potatoes of an Acre, in	
		Large.	*Smal*
Whole Potato, .	100 lbs. ground bones and 50 lbs. muriate of potash.	410	592
One-half a Potato, .		431	188
		841	780

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PLAT II.

ED POTATO.	Fertilizer Applied.	Yield of Potatoes upon One-fifth of an Acre, in Pounds.		
		Large.	*Small.*	*Total.*
Potato, .	Not fertilized.	321	398	719
lf a Potato, .		353	194	545
		674	592	1,264

PLAT III.

		Large.	*Small.*	*Total.*
Potato, .	100 lbs. ground bones and 96 lbs. potash-magnesia sulphate.	747	503	1,250
lf a Potato, .		658	315	974
		1,405	818	2,224

careful study of the above tables leads to the following usions : —

Medium-sized whole potatoes give better results than potatoes obtained from tubers of a corresponding size.

Disregarding the results of the first year, when previously ng liberal resources of plant food are apt to render the in-e of an additional supply of manurial substances less ed, it appears that the sulphate of potash produced better ts in our case than the muriate of potash.

The premature dying out of the vines, accompanied by t or scab, or both, must be considered a controlling cause exceptionally large proportions of small potatoes.

B. — *Observations with Scabby Potatoes.*

ese experiments were inaugurated during the past season e purpose of inquiring into the circumstances which con-he development and the propagation of the "scab" on oes.

e first year's work in this connection has been confined to sk of observing the behavior of scabby potatoes as *seed* oes, under some definite previous treatment. To prevent

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a possible propagation of scab, by infected seed potat
the new crop, the following course was adopted: Thor
scabby potatoes obtained from the previously-described
mental plats were treated with some substances know
destructive to various forms of parasitic growth. This
tion was carried out with the intention of destroying the
gating power of adherent germs of an objectionable ch
before planting the potatoes.

The field for the observation was distinctly separa
other experimental plats for the cultivation of potatoes.
been used for many years previous for the raising of gra
had since been planted but once, — the preceding year,
corn. The land was prepared by ploughing and harrow
the same way as other potato fields: it was fertilized br
with the same amount of fertilizer per acre as Plat N
1884 and 1885, in the above-described experiment
namely, six hundred pounds of ground bones and two b
and ninety pounds of potash-magnesia sulphate.

The field was subdivided into five plats of equa
eighty feet long and fifty feet wide, and the potatoes
quently planted in rows three feet three inches apart, wi
three feet from each other in the rows. Three feet o
was left unoccupied between the different plats. The
seed potatoes selected for the trial were, as far as prac
of a uniform medium size. Each lot was immersed
particular solution prepared for the different plats; afte
kept there for twenty-four hours they were remove
directly planted without any other operation.

Plat No. 1 (north end of field). The seed potatoes
this case were smooth and healthy; they were planted
being subjected to any preparatory treatment. This
was adopted to learn whether soil, fertilizer or atmo
agencies of the season would favor the appearance of t
in the crop.

Plat No. 2. The potatoes were allowed to remain for
four hours in a saturated solution of muriate of potash
being planted.

Plat No. 3. A strong solution of hypochlorite of lime (
ing lime) was applied in a similar way for the prepar
the seed potatoes as in Plat No. 2.

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t No. 4. A saturated solution of carbolic acid in water
l in this instance for the treatment of the seed potatoes.
t No. 5. The seed potatoes used in this plat were treated,
us to planting, with a strong abstract by cold water of
Potato Protector" of John Butterworth & Co., Mansfield,
This material was sent to the Station, for an opinion
ling its merits, at a time when active preparations were
way to test by field experiments whether substances like
above stated would prove efficient to prevent the propaga-
of "scab" by seed potatoes. The practice of treating
and other seeds for similar purposes with solutions of
te of copper, etc., is not uncommon in other localities.
"Potato Protector" proved to contain quite a noticeable
ty of a powerful agent, hypochlorite of lime, it was
ht best to introduce the material into our experiment,
d of offering a mere opinion regarding its merits. The
s of an examination into the composition of the "Potato
ctor" are published with some comments at the close of
hapter.

potatoes were planted in all plats on the same day,
, 1886; the young vines appeared on Plats 1 and 5,
5, whilst on Plats 2, 3 and 4 they did not show themselves
the 29th of May, and not as generally and evenly as on
1 and 5. This difference in growth could be noticed until
ds the close of June, when the vines on all plats looked
y vigorous and thrifty. The vines on all the plats were,
stage, vigorously attacked by the potato bug, and were
cted against their destructive influence by a repeated
ling with a solution of Paris green. They began to bloom
. The vines on Plat 1 began first to turn yellow and to
July 30; those on the remaining plats began to change
milar way August 8. The tops on all the vines were
generally dried up August 18. The potatoes were har-
on the entire field August 30. The yield on all plats was
nd the quality of the potatoes, almost without excep-
excellent; this seemed to be most striking in regard to
from Plats 2, 3 and 4, which had been in the beginning
season somewhat behind in growth. Here and there
be seen a potato with a small mark of scab; a large pro-
n were perfectly smooth and without any sign of it.

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These results are recorded merely as those of a first ex ment. They are, however, not without some interest considered in connection with previous observations. The that a scabby potato may produce, under certain circumsta a smooth and otherwise excellent potato must be accep The recognition of this fact does not, however, entitle us to conclusion that it is a safe course to advise planting sc potatoes with the expectation of raising a superior, he potato, without awaiting the results of a repetition of the ex ment under modified circumstances. Good potatoes have raised before from seed potatoes suffering from scab wit any previous treatment similar to ours. Without any i tion of anticipating the results of future observations, or to out with certainty the exact cause of the results, we fe clined to consider a difference in the condition of the soil o old and new experimental potato plats, the real seat of troubles; for the former yielded most inferior, scabby pota whilst the latter produced a most superior, smooth potato u otherwise identical conditions as far as soil, mode of cultiv and kind of fertilizer, upon land in close proximity, durin same season.

Potato Protector.

The material consisted of a brownish mixture of or and earthy substances, which smelled strongly of hypochl acid. It deflagrated violently at red heat, and left 35.40 cent. of crude ash, which contained 12.40 per cent. of chlo 14.15 per cent. of calcium oxide and 0.11 per cent. of phoric acid, the rest being silicious matter.

A watery solution was dark-colored and smelled like a coction of some herb, possibly the Bone-set (*Eupatorium foliatum*). A solution of some whitish substances it cont quickly decolorized an indigo solution.

From the above observation it appears that the substan a mixture of some herbaceous matter with hypochlorite of (bleaching lime) as a prominent constituent.

The claim of the manufacturer is stated in the subse copy of a circular sent on with the material for our e nation: —

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ners and Gardeners.

LEMEN: — Permit me to call your attention to the remedy for the Bug scourge, called "The Potato Protector."

non-poisonous, cheap, easy of application, and effective. It is ed mostly of vegetable substances, which are warranted not to man or beast. For twenty-five cents you can buy enough of it to e bushel of seed, and it is warranted to be a cheaper protector for unt of land this seed will plant than a *single* application of Paris ould be, and ordinarily a second and third application of the poison e made to protect the plants. But the *method of applying the Pro- its strong point.* The strength of one package of the Protector is red to five gallons of water, according to directions on each package; olution one bushel of seed potatoes, cut and ready to plant, is soaked half hour. The plants from seed thus treated will be so distasteful ugs, both young and old, that they will not molest them, and the f the Protector, so distasteful to the bugs, *is warranted not to be ble in the potatoes.* Thus by a single treatment, that may be done ate of a bushel an hour, without expensive help, the same results red at one-tenth the labor of applying Paris Green.

eason's trial will convince you that the Protector will keep the bugs e inventor, Mr. John Butterworth, after six years' experimenting, the Protector in 1884. That season it alone, of many others, stood , and in 1885 its value was confirmed by treating alternate hills, e hills not treated were destroyed, and slugs and winged bugs n the treated hills would not feed or remain there.

JOHN BUTTERWORTH & Co.,
Mansfield, Mass.

experiment does not confirm the claim of the manufac- for potato bugs were as plenty on the vines of the es treated in the above-described manner by a solution e Potato Protector" as on any other of our different mental potato plats. Aside from this fact, it is but an justice to the manufacturer to state that he invited by n actual investigation on our part into his claim.

should not, however, advise the preparation of a mixture ochlorite of lime, or bleaching lime, with herbaceous mat- we did intend to turn the peculiarity of the former to t, for in that case it soon suffers serious alterations in position.

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6. Miscellaneous Field Experiments with Fa Garden Crops.

The field observations recorded under the above hea made, in the majority of cases, on a comparatively scale. The supply of the seeds was, in many instanc small; some of them have been sent on by the Unite Department of Agriculture in Washington, D. C. T carried on in this connection has had, for obvious rea other aim than to study either the adaptation of some crop to our climate, or to compare some new variety of nent garden crop with those frequently raised in our s the State. The field set aside for these experiments good state of cultivation. Barnyard manure, supplem commercial phosphates and potash compounds, had b in the past as manure; no alteration was made in thi during the past season. The different crops were seed in drills three feet three inches apart, and subsequen clean by a frequent use of the cultivator.

1. *Cleveland's Rural New Yorker Pea* (Pisum).— was planted May 8; the young plants appeared May 1 bloomed June 14. The first crop was ready for table us The fully matured vines had from five to six well-fill Three rows forty feet long produced eight pounds of vines and six and one-half pounds of air-dried peas.

2. *Cleveland's Alaska Pea.*—The seeds were planted the young plants appeared May 19; they began to blo 14, and the first crop for table use was ready July 1 matured vine had from five to six well-filled pods. Th forty feet long yielded eight pounds of air-dried vines pounds of air-dried peas.

3. *Champion of England Pea.*—The seed was plan 8; the young plants made their appearance May 2 showed the first flowers June 28. The first crop for was ready July 15; they ceased growing August 7. rows forty feet long produced twenty-three pounds of vines and three and one-half pounds of air-dried peas.

4. *Marrowfat Peas.*—The seeds were planted May young plants appeared May 20; they showed their first July 5, and the first crop was ready for table use July

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ceased growing and began dying out August 7. Three forty feet long yielded twenty-five pounds of air-dried and three and one-half pounds of air-dried peas.

e weights of the vines and peas were taken on the same three to four months after storing.

Cleveland's Improved Valentine Beans (Phaseolus). — The were planted May 8; they appeared above ground May nd began blooming July 5; the beans reached their full nd the pods turned yellow August 10. The air-dried vines ied twenty-six and one-half pounds; the air-dried beans e pounds.

Horse Bean (Vicia faba). — Three varieties of this fodder were raised during the past year with much success. A iption of some varieties of this reputed fodder plant has published in our previous report. Its adaptation to our s well as its special agricultural value for green manuring, or the production of a valuable bean for feeding purposes, een discussed in that connection. Our attention during ast season was mainly directed towards the question, proportion of the entire matured crop consists of straw mpty pods, and what of beans? The results of this in- are stated below.

all horse bean. The seeds were planted May 12; the g plants appeared May 22; they began to bloom July 10, two and one-half feet high; the first seeds formed August he matured plants were cut and stooked September 13. e rows forty feet long produced twenty pounds of air-dried and pods and twelve pounds of beans. The Jaeger bean, ently but another name for small horse bean, yielded from me area twenty pounds of air-dried straw and pods and een and one-half pounds of air-dried beans. A larger y of horse bean yielded, under similar circumstances, yet a larger area, two hundred pounds of air-dried beans and hundred and seventy-five pounds of air-dried straw and or for every ten pounds of dry beans thirteen and one- er pounds of dried straw and pods.

Lupine. — The white lupine (Lupinus albus) has been l successfully for several years upon the fields of the on. Its particular value as a green manure has been illus- l by experiment. During the last season two varieties

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have been added to our experimental field for forag
Three varieties, the white, the yellow and the blue,
quently cultivated by European agriculturalists. All
sidered, more or less, a valuable addition to farm crops
eral. The yellow variety is generally considered the mo
able of the three, for it is equally well fitted for green
or hay, or for green manure, and best adapted for
sandy soil, where clover cannot be raised with succes
seeds were planted May 12; the young plants were
May 22; they began blooming when two and one-half fe
July 26; the seeds first formed August 7; the matured
were cut September 11. The blue lupine produced th
one-half pounds of air-dried seeds to twelve and one-half
of air-dried stems and pods; the white and yellow variet
duced two pounds of air-dried seeds to twenty pounds
dried stems and pods.

Besides the above observations, small trials have al
made with the following seeds: —

Vicia villosa, } For sheep pastures.
Spergulum maximum, }
Sesame (Oil plant).
Pyrethrum roseum.
Some varieties of corn: *Pride of the North*, from Minnesota; *
Corn, Springfield.
Some varieties of Texas grasses.
Alsike Clover.
Melilotus albus (Honey Lotus).
Lucerne (Alfalfa).
Some varieties of oats: *Harris Oats*, from Alabama, and *White
Oats*, from Russia.
Melon Barley, from Russia.

Some of the results obtained in this connection are
cient interest to encourage further trials on a larger sc
ing the coming season. The new seeds of the varieties
and those of the new variety of barley especially are r
for that purpose.

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ALUATION OF FERTILIZERS, AND FERTILIZER ANALYSES.

---

e valuation of a fertilizer is based on the average trade of the fertilizing elements specified by analysis. The y value of the higher grades of agricultural chemicals and e higher-priced compound fertilizers, depends in the major- f cases on the amount and the particular form of two or essential articles of plant food — *i. e.*, phosphoric acid, gen and potash — which they contain. The valuation which ly accompanies the analyses of these goods informs the mer, as far as practicable, regarding the cash retail price ich the several specified essential elements of plant food, efficient form, have of late been offered in our large ets.

e market value of low-priced materials used for manurial oses, as salt, ashes, various kinds of lime, barnyard re, factory refuse and waste materials of different descrip-, quite frequently does not stand in close relation to their ical composition. Their cost varies in different localities. l facilities for cheap transportation and more or less advan- us mechanical condition for a speedy action, exert, as a a decided influence on their selling price.

e wholesale market price of manurial substances is liable rious fluctuations; for supply and demand exert here, as as in other branches of commercial industry, a controlling ence on their temporary money value. As farmers have in exceptional instances a desirable chance to inform selves regarding the conditions which control the market , the assistance rendered in this direction by agricultural ists charged with the examination of commercial fertilizers

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cannot otherwise but benefit, ultimately, both f
manufacturers.

The market reports of centres of trade in Ne
New York and New Jersey, aside from consultation
ing manufacturers of fertilizers, furnish us the nece
mation regarding the current trade value of fertiliz
ents. The subsequent statement of cash values i
trade is obtained by taking the average of the wh
tations in New York and Boston during the six mon
ing March 1, 1886, and increasing them by 20 p
cover expenses for sales, credits, etc.

These trade values, except those for phosphoric a
in ammonium citrate, were agreed upon by the
Stations of Massachusetts, Connecticut and New Je
in their several States for the present season.

Trade Values of Fertilizing Ingredients
Materials and Chemicals.

Nitrogen in ammonia salts, ...
Nitrogen in nitrates, ...
Nitrogen in dried and fine-ground fish, ...
Organic nitrogen in guano and fine-ground blood and meat,
Organic nitrogen in cotton seed, linseed meal, and in castor po
Organic nitrogen in fine-ground bone, ...
Organic nitrogen in fine medium bone, ...
Organic nitrogen in medium bone, ...
Organic nitrogen in coarse medium bone, ...
Organic nitrogen in coarse bone, horn shavings, hair, and fish s
Phosphoric acid, soluble in water, ...
Phosphoric acid, soluble in ammonia citrate,* . . .
Phosphoric acid, insoluble in dry, fine-ground fish and in fine
Phosphoric acid, insoluble in fine medium bone, . .
Phosphoric acid, insoluble in medium bone, . . .
Phosphoric acid, insoluble in coarse medium bone, . .
Phosphoric acid, insoluble in coarse bone, ...
Phosphoric acid, insoluble in fine-ground rock phosphate,
Potash as high grade sulphate, ...
Potash as kainite, ...
Potash as muriate, ...

* Dissolved from two grams of phosphate, unground, by 100 cc. ne
ammonia citrate, sp. gr. 1.09, in 30 minutes at 65 deg. C., with agitation
utes, commonly called "reverted" or "backgone" phosphoric acid.

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he above trade values are the figures at which, on March 1, 6, the respective ingredients could be bought at retail for per pound in our leading markets in the raw materials, ch are the regular source of supply.

hey also correspond to the average wholesale prices for the months ending March 1, plus 20 per cent in case of goods which we have wholesale quotations. The calculated values ined by the use of the above figures will be found to agree y with the reasonable retail prices in case of standard raw erials, such as —

Sulphate of Ammonia,	Dry Ground Fish,
Nitrate of Soda,	Castor Pomace,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Bone,
Dried Blood,	Azotin,

Plain Superphosphates.

DE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADE.

he organic nitrogen in these classes of goods are here ed at the highest figures laid down in the trade values ertilizing ingredients in raw materials, namely, 17 cents pound; it being assumed that the organic nitrogen is de- l from the best sources, as bone, blood, animal matter, her equally good forms, and not from leather, shoddy, hair ny low-priced inferior form of vegetable matter, unless the rary is ascertained.

soluble phosphoric acid has been valued at 3 cents, it being med, unless found otherwise, that it is from bone or a simi- ource, and not from rock phosphate. In this latter form nsoluble phosphoric acid is worth but 2 cents per pound. sh is rated at 4¼ cents per pound, if sufficient chlorine resent in the fertilizer to combine with it to make iate.

there is more potash present than will combine with the rine, then this excess of potash will be counted as sulphate. ntroduce large quantities of chlorides, common salt, etc., fertilizers, claiming sulphate of potash as a constituent, is a tice which, in our present state of information, will be con-

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sidered of doubtful merit. The use of the highest tr
is but justice to these articles in which the costliest
are expected to be used.

In most cases the valuation of the ingredients in
phates and specials falls below the retail price of
The difference between the two figures represents th
turer's charges for converting raw materials into ma
articles. These charges are for grinding and mixin
or barrelling, storage and transportation, commissio
and dealers, long credits, interest on investment,
and finally profits.

The prices stated in this report in connection wit
of commercial fertilizers refer to their cost per ton of
on board of car or boat near the factory or place of g
tribution. To obtain the valuation of a fertilizer
money-worth of its fertilizing ingredients), we m
pounds per ton of nitrogen, etc., by the trade value
We thus get the values per ton of the several i
and, adding them together, we obtain the total val
ton.

The mechanical condition of any fertilizing mater
or compound, deserves the most serious consideratio
ers, when articles of a similar chemical character
for their choice. The degree of pulverization contr
without exception, under similar conditions, the ra
bility, and the more or less rapid diffusion of th
articles of plant food throughout the soil.

The state of moisture exerts a no less important i
the pecuniary value, in case of one and the same ki
stance. Two samples of fish fertilizer, although eq
may differ from 50 to 100 per cent. in commercia
account of mere differences in moisture.

Crude stock for the manufacture of fertilizers and
terial of various descriptions sent to the Station for e
are valued with reference to the market prices of thei
constituents, taking into consideration at the same
general fitness for speedy action.

A large percentage of commercial fertilizing mater
of refuse matter from various industries. The com
these substances depends on the mode of manufact

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The rapid progress in our manufacturing industries is liable 'ect at any time, more or less seriously, the composition of efuse. A constant inquiry into the character of the agri- ral chemicals and of commercial manurial refuse sub- es offered for sale cannot fail to secure confidence in their osition, and to diminish financial disappointment in con- ence of their application. This work is carried on for urpose of aiding the farming community in a clear and igent appreciation of the substances for manurial pur- s.

nsumers of commercial manurial substances do well to whenever practicable, on a guaranty of composition with ence to their essential constituents, and to see to it that ill of sale recognizes that point of the bargain. Any mis- or misunderstanding in the transaction may be readily ted, in that case, between the contending parties. The nsibility of the dealer ends with furnishing an article sponding in its composition with the lowest stated quantity ch specified essential constituent.

Connecticut Tobacco Stems.

[Sent on from South Deerfield, Mass.]

	Per cent.
re at 100° C.,	10.65
horic acid (5 cents per pound),	0.51
ium oxide (4¼ cents per pound),	7.22
m oxide,	3.39
esium oxide,	1.12
en (17 cents per pound),	2.65
ble matter,	0.29
tion per 2,000 lbs.,	$14 66

e composition of the above sample corresponds well with noticed on previous occasions. (See First Annual Report, 103.)

e potash was almost entirely soluble in water at ordinary erature; 6.85 parts of the entire amount present. The feature was noticed in regard to the Havana tobacco

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Havana Tobacco Stems.

[Sent on from South Deerfield, Mass.]

Moisture at 100° C.,	
Phosphoric acid (5 cents per pound),	
Potassium oxide (4¼ cents per pound),	
Calcium oxide,	
Magnesium oxide,	
Nitrogen (17 cents per pound),	
Insoluble matter,	
Valuation per 2,000 lbs.,	

The amount of nitrogen in this sample of tob (Havana) is exceptionally low, about one-third of in other samples offered for sale in our section of th icut River valley. (See Second Annual Report, The difference in nitrogen causes the low valuation compared with that of the preceding analysis. T was handed to us with the statement that it had for imparting the odor of Havana tobacco to othe The odor had been removed apparently by a steamin for the mineral constituents, with the exception of sium oxide, corresponded fairly with those in th described in our Second Annual Report. Farmers to be careful in buying the article without stated g composition.

Hop Refuse.

[Sent on for examination from Lawrence, Mass.]

Moisture at 100° C.,	
Dry vegetable matter,	
Nitrogen,	
Calcium oxide,	
Magnesium oxide,	
Phosphoric acid,	
Potassium oxide,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

This refuse from breweries differs from the one described merely by a larger percentage of nitrogen

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lemented by some phosphoric acid and potash it may in place of barnyard manure. The average barnyard re (partly rotten) is usually stated to contain 0.5 per cent. rogen, 0.26 per cent. of phosphoric acid and 0.6 per cent. tassium oxide.

Rotten Brewers' Grain.

[Sent on for examination from Lawrence, Mass.]

	Per cent.
re at 100° C.,	78.77
getable matter,	21.23
en,	0.72
m oxide,	0.26
sium oxide,	0.15
oric acid,	0 43
ium oxide,	0.04
ble matter,	0.59
ion per 2,000 lbs.,	$2 71

e general character of the above-mentioned substance bles that of barnyard manure. It contains more nitrogen hosphoric acid, and less potash than the average barnyard re. By increasing the latter ingredients to one-half a per a fair substitute for barnyard manure may be obtained.

Glucose Refuse (dry).

[Sent on for examination.]

	Per cent.
re at 100° C.,	8.10
getable matter,	91.80
en,	2.62
oric acid,	0.29
sium oxide,	0.02
n oxide,	0.18
oxide,	0.12
um oxide,	0.15
le matter,	0.07
on per 2,000 lbs.,	$9 33

s material consists mainly of the skins of corn; it is evi- the insoluble residual matter left behind after the con- n of the starch into glucose syrup. The manurial value article rests mainly on the amount of nitrogen it contains

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in form of insoluble nitrogenous matter. To re
efficient manure requires, in the majority of cases, a l
tion of phosphoric acid and potash.

Damaged Cotton Seed Meal.

[Sent on from Greenfield, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Potassium oxide,	
Magnesium oxide,	
Calcium oxide,	
Nitrogen,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

Analysis of Hen Manure.

[Sent on from Townsend, Mass.]

Moisture at 100° C.,	
Phosphoric acid,	
Calcium oxide,	
Magnesium oxide,	
Potassium oxide,	
Nitrogen in organic matter,	
Nitrogen in actual ammonia,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

The material was dry, and contained the usual
feathers, short pieces of coarse vegetable matter,
stances, etc., yet not in an extraordinary degree.
the hen manure depends not less on the care which
on its keeping than on the kind of food the fow
The excretion of birds, on account of their peculia
undergoes a rapid change; a large amount of amm
formed, which reduces materially its manurial valu
is allowed to escape. A liberal use of plaster, of
of good loam is highly recommendable for the abso
ammonia. The safest way to secure the full benefit
pings is to gather them quite frequently, and to
any of the previously-mentioned materials. A san
little use as an absorbent.

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Fresh Hen Manure.

[Sent on from Townsend, Mass.]

	Per cent.
re at 100° C.,	45.73
oric acid (6 cents per pound),	0.47
um oxide (4¼ cents per pound),	0.18
n oxide,	0.97
en, total (17 cents per pound),	0.79
ble matter, sand, etc.,	39.32
ion per 2,000 lbs.,	$3 42

s sample of fresh hen manure came from the same party sent on the dry sample. It was inferior in quality as ared with the first material; it contained for the same nt of organic matter about twice as much worthless earthy r. In a dry state, corresponding with the first sample, 8 ent. of moisture, it would be worth only one-half as much, about $5 per ton.

Ashes of Chestnut Railroad Ties.

[Sent on from Waltham, Mass.]

	Per cent.
re at 100° C.,	6.15
n oxide,	4.71
sium oxide,	1.80
um oxide,	0.19
oric acid,	1 54
ble mineral matter,	77.83

e material was of a dark brown color, and evidently not ure ash, for it contained 77.83 per cent. of worthless y matter. The ash in the above-described state does not arrying any considerable distance; it is worth much less eached ashes.

Waste Hemlock Tan Bark Ashes.

[Sent on from Peabody, Mass.]

	Per cent.
re at 100° C.,	4.87
oric acid,	0.13
n oxide,	37.26
sium oxide,	2.98
um oxide,	2.10
ble matter,	24.33

s ash, from a waste product of a tannery, has lost a large ntage of its original potash.

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Hard Pine Wood Ashes.

[Sent on from South Lincoln, Mass.]

Moisture at 100° C., ...
Total insoluble matter, ...
Insoluble mineral matter, ...
Calcium oxide, ...
Magnesium oxide, ...
Phosphoric acid, ...
Potash, ...

This material shows an exceptionally high per
potash.

Canada Wood Ashes.

[I., II. Sent on from Concord, Mass. III., IV. Sent on from South Deer

	I.	II.	III.
Moisture at 100° C., ...	17.00	18.15	4.90
Potassium oxide, ...	4.28	4.80	7.42
Calcium oxide, ...	31.31	30.69	42.10
Magnesium oxide, ...	2.36	3.71	3.55
Phosphoric acid, ...	3.34	3 26	2.00
Insoluble matter, ...	15.50	17.35	7.12

These samples represent the extremes of compositi
in our section of the State. The use of Canada ash
late steadily increased, and the cost gradually decline
25 cents per bushel of forty-five to fifty pounds. T
prices by the car-load at Amherst and in its vicinity.

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Wood Ashes.

on from South Framingham, Mass. II. Sent on from West Tisbury, Mass. III., IV. Sent on from South Sudbury, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
e at 100° C.,	5 10	17.63	17.43	11.76
hosphoric acid,	1.30	1.66	1.70	1.41
ium oxide,	3.24	3.42	2.88	3.12
oxide,	39.07	34.54	29.87	32.81
ım oxide,	5.76	3.67	4.30	5.58
le matter (before calcination),	9.20	11.08	18.38	16.57
le matter (after calcination),	7.68	8.86	15.48	13.26

difference in moisture in the above analyses explains hat the difference in potash.

Wood Ashes. (Two samples.)

[Sent on from South Deerfield Farmers' Club.]

	Pounds per Hundred.	
	I.	II.
e at 100° C.,	16.75	11.79
oric acid,	1.79	1.34
ı oxide,	32.28	34.62
ium oxide,	3.48	4.02
ım oxide,	1.80	6.68
le matter,	16.55	9.50

first article is evidently a partly leached wood ash. vo samples differ mainly in regard to their relative amount ash. This difference expressed in money value amounts n 26 to 27 cents per hundred weight of ashes, allowing nts per pound of potassium oxide in case of wood ash.

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Wood Ashes.

[I., II. Sent on from Somerset, Mass. III. Sent on from Byfie

	Per	
	I.	
Moisture at 100° C.,	4.82	2
Phosphoric acid,	3.07	1
Calcium oxide,	34.42	45
Magnesium oxide,	4.09	2
Potassium oxide,	4.56	1
Insoluble matter (before calcination),	18.17	12
Insoluble matter (after calcination),	15.37	7

Nos. II. and III. are evidently leached wood ash

Ashes of Cotton Seed Hulls.

[I. Sent on for examination from South Deerfield, Mass. II. Sent
Amherst, Mass.]

	Pound
	I.
Moisture at 100° C.,	10.9
Phosphoric acid (6 cents per pound),	6.9
Calcium oxide,	5.7
Magnesium oxide,	9 1
Potassium oxide (5½ cents per pound),	25 3
Insoluble matter,	10.4
Valuation per 2,000 pounds,	$36 1

There is evidently a considerable variation in t
tion of this article. Direct communication from a w

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ern source accounts for this fact by stating that more or eds are not unfrequently mixed with hulls when burned. icle which represents a high money value, like the above al, ought to be bought only on analysis.

Cotton Seed Hull Ash.

[Sent on from Northampton, Mass]

	Per Cent.			
	I.	II.	III.	IV.
re at 100° C.,	7.43	7.77	7.30	8.23
oric acid (6 cents per pound),	5.21	9.68	9.59	11.19
sium oxide,	10.11	14.48	14.81	16.71
n oxide,	6 71	18.42	12.23	12.43
um oxide (5½ cents per pound),	25.76	17.34	19.15	24.91
le matter (before calcination),	12.36	11.30	10.88	7.34
le matter (after calcination),	12.18	6.34	8.86	5.18
on per ton of 2,000 pounds,	$36 78	$30 70	$32 58	$10 83

Cotton Seed Hull Ash.

[Sent on for examination from Northampton, Mass.]

	Per cent.
e at 100° C.,	2.30
n oxide,	11.63
ium oxide,	15.24
oric acid (6 cents per pound),	13,67
um oxide (5½ cents per pound),	30.82
le matter,	21.65
on per 2,000 pounds,	$50 30

percentage of potash found in the above sample is ex- nally high. The same may be said of the phosphoric

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Muriate of Potash.

[I. Sent on from Northampton, Mass. II. Sent on from Willian
III. Sent on from South Deerfield, Mass.]

	Pounds per	
	I.	II.
Moisture at 100° C.,	1.02	2.
Potassium oxide,	50.09	54.
Sodium oxide,	9.94	Not d
Magnesium oxide,	0.63	Not d
Valuation per 2,000 lbs.,	$42 58	$46

The large amount of moisture in the last san
somewhat the lower percentage of potassium oxide
cipal admixture of salines in this brand of potas
consists of common salt, usually from 14 to 18 per

Muriate of Potash.

[I. Sent on from Fall River, Mass. II. Sent on from Amher

	I.
Moisture at 100° C.,	0.4
Potassium oxide (4¼ cents per pound),	50.7
Sodium oxide,	10.0
Valuation per 2,000 lbs.,	$43 2

Sulphate of Potash.

[Sent on for examination, Amherst, Mass.]

Moisture at 100° C.,
Potassium oxide (5½ cents per pound),
Sodium oxide,
Sulphuric acid (5½ cents per pound),
Chlorine,
Insoluble matter,

Valuation per ton of 2,000 lbs.,

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Double Manure Salt.

[Sent on from New York.]

I. Crystallized double manure salt. II. Commercial double manure salt]

	Per Cent.	
	I.	II.
ure at 100° C.,	11.58	6.58
esium oxide,	10.81	11.50
m oxide,	–	2.93
m oxide,	3.16	4.16
ium oxide (5½ cents per pound),	22.40	23.28
uric acid,	39.89	43.43
ne,	0.14	1.08
ble matter,	0.26	1.80
tion per 2.000 lbs.,	$24 64	$25 61

e first-named article consisted of large, clear, colorless well-developed crystals, which, in consequence of a loss of r, turned gradually whitish on exposure to the air. The d one consisted of a yellowish white powder, and repre- the article for our markets. Both salines consist essen- of sulphate of potash and sulphate of magnesia, and are rkably free from chloride (common salt, etc.).

Fish Waste.

t on from Boston. II. Sent on from Gloucester. III. Sent on from Marshfield.]

	Per Cent.		
	I.	II.	III.
ure at 100° C.,	71.11	8.62	40.35
ic and volatile matter,	–	50.16	73.01
	–	49.84	26.99
phosphoric acid,	0.60	6 99	2.94
e phosphoric acid,	–	0.67	–
ted phosphoric acid,	–	2.90	1.06
ble phosphoric acid,	–	3.42	1.88
gen,	2 21	4.97	5.07
ble matter,	–	0.74	0.17
tion per 2,000 lbs.,	$4 58	$23 75	$12 50

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The difference in the moisture and in the mecha tion of the above-stated articles controls largely th value. Samples I. and III. consisted of large pi meat with fatty matter; the valuation is based in on that of coarse fish scrap. Sample II. corres with a fair specimen of fish guano.

Dried Fish.

[Sent on from North Hatfield, Mass.]

	Per	
	I.	II
Moisture at 100° C.,	8.07	9
Total phosphoric acid,	5.87	8
Soluble phosphoric acid (8 cents per pound),	0.58	0
Reverted phosphoric acid (7½ cents per pound),	2 34	4
Insoluble phosphoric acid (3 cents per pound),	2.95	4
Nitrogen (17 cents per pound),	7.80	8
Insoluble matter,	3.86	3
Valuation per ton of 2,000 lbs.,	$32 71	$37

Peruvian Guano.

[Sent on for examination, Taunton, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Potassium oxide,	
Nitrogen (total),	
Actual ammonia (equal to 5.43 per cent. nitrogen),	
Organic nitrogen,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

Apparently an artificial product.

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Fish and Potash.

[Sent on for examination from Medfield, Mass.]

	Per cent.
re at 100° C.,	23.58
hosphoric acid,	6.26
phosphoric acid (8 cents per pound),	3.58
ed phosphoric acid (7½ cents per pound),	1.33
le phosphoric acid (3 cents per pound),	1.35
um oxide (4¼ cents per pound),	3.24
en (17 cents per pound),	3.07
le matter,	1.90
ion per 2,000 lbs.,	$21 73

High Grade Superphosphate.

[Sent on from Boston, Mass.]

	Per cent.
re at 100° C.,	5.03
hosphoric acid,	25.36
ed phosphoric acid,	15.23
phosphoric acid,	0.25
le phosphoric acid,	9.88
ric acid,	0.22
n oxide,	0.70
of alumina and iron,	24.95
sium oxide,	0.10
le matter,	18.91
on per ton of 2,000 lbs.,	$29 18

German High Grade Superphosphate.

Sent on from New York City, N. Y., by a Boston manufacturer of fertilizers.
II. Sent on from Boston, Mass.]

	Pounds per Hundred.	
	I.	II.
re at 100° C.,	15.24	7.50
hosphoric acid,	45.54	43.24
phosphoric acid,	41.56	36.62
ed phosphoric acid,	3.58	5.67
le phosphoric acid,	0.40	0.95
le matter,	5.20	2.50
on per 2,000 lbs.,	$78 47	$67 67

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The material serves for the manufacture of high "formula fertilizers." The amount of sulphuric a in either sample did not exceed 3.5 per cent. This that the product is obtained by a different proce ordinary superphosphates; it is most likely the isola portion of the latter evaporated after its separatio insoluble sulphate of lime, etc.

Flamingo Guano.

[Sent on from Worcester, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Potassium oxide,	
Nitrogen,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

Dissolved Boneblack.

[Sent on from South Deerfield, Mass.]

Moisture at 100 C.,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Insoluble matter,	
Valuation per 2,000 lbs.,	

The article is a fair representative of its kind; it is rather more than usual.

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Compound Fertilizers.

d II. Sent on from Methuen, Mass. III. Sent on from Groton, Mass. IV. Sent on from Lowell, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
ture at 100° C.,	9.03	17.24	23.00	10.40
nic and volatile matter,	34.28	51.04	55.30	48.76
	65.72	48.96	44.70	51.24
l phosphoric acid,	7.96	6.06	12.67	17.88
ble phosphoric acid,	0.16	3.97	1.41	4.54
rted phosphoric acid,	2.52	0.93	7.36	9.78
uble phosphoric acid,	5.28	1.16	3.90	3.56
ssium oxide,	5.92	1.02	1.03	0.10
gen,	1.30	1.92	1.73	3.03
uble and silicious matter,	4.16	22.36	3.70	1.88
ation per ton of 2,000 lbs.,	$16 66	$15 85	$22 42	$34 37

Compound Fertilizers.

[Sent on for examination from South Hadley Falls, Mass.]

	Per Cent.		
	I.	II.	III.
ure at 100° C.,	5.24	8.08	12.45
phosphoric acid,	15.07	10.44	6.62
le phosphoric acid,	0.29	2.88	0.58
ted phosphoric acid,	3.57	4.00	2.53
ble phosphoric acid,	11.21	3.56	3.51
gen,	5.77	4.03	4.17
sium oxide,	–	7.64	6.45
ble matter,	1.23	1.06	5.00
tion per ton of 2,000 lbs.,	$32 17	$32 94	$26 50

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Compound Fertilizers — Concluded.

[IV. Sent on from Amesbury, Mass. V. Sent on from Newburyp

	Pe
	IV.
Moisture at 100° C.,	9.21
Total phosphoric acid,	21.10
Soluble phosphoric acid,	0.77
Reverted phosphoric acid,	7.82
Insoluble phosphoric acid,	12.51
Nitrogen,	3.03
Potassium oxide,	–
Insoluble matter,	1.02
Valuation per 2,000 lbs.,	$32 14

Steamed Bone.

[I. Sent on from Monson (fine ground). II. Sent on from Worceste
many coarse pieces).]

	Pe
	I.
Moisture at 100° C.,	5.70
Organic and volatile matter,	40.68
Ash,	59.32
Total phosphoric acid,	21.99
Reverted phosphoric acid,	3.23
Insoluble phosphoric acid,	18.76
Nitrogen,	3.53
Insoluble matter,	2.10
Valuation per 2,000 lbs.,	$34 20

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e difference in the mechanical condition of the steamed
causes the variation in the valuation of the phosphoric
and of the nitrogen. The first sample was of a good
ge fineness; the second consisted largely of coarse yet
s pieces; the phosphoric acid in the latter is valued at four
per pound, and the nitrogen thirteen cents, whilst five
fteen respectively are allowed in case of the former.

Ground Bone.

e-ground bone sent on from Concord, Mass. II. Fine-ground bone compost sent on from Concord, Mass.]

	Per Cent.	
	I.	II.
re at 100° C.,	4.78	21.73
c and volatile matter,	25.48	38.76
	74.52	61.24
hosphoric acid,	29.83	9.81
ed phosphoric acid,	9 22	0.88
le phosphoric acid,	20.61	8.93
um oxide,	-	2.95
en,	2.03	0.50
le matter,	0.30	8.00
ion per ton of 2,000 lbs.,	$34 39	$14 26

above samples of rendered, ground bones, and of a bone
st prepared from the former by mixing with wood ashes,
ent on to ascertain the exact changes which the material
ffered after a few months' keeping. The analyses show
luble phosphoric acid, and also less nitrogen for the same
t of phosphoric acid in the bone compost, when compared
he original bones.

operation of composting bones with wood ashes
d in the present case a decided loss, for more than one-
of the original nitrogen had been lost in the form of am-
. A sample of the material, sent on for examination,

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gave evidence of the gradual escape of ammonia wh
a few days in a well-closed bottle.

To derive benefit from composting bones with
requires a careful protection of the mixture against
of ammonia, which is invariably formed in the cour
The mixture ought to be covered at once with a lay
loam, from six to eight inches in thickness. In
this, it is well to scatter some gypsum (plaster)
kieserite (crude sulphate of magnesia) over the enti
heap. The practice of mixing the ground bone
three to four times its bulk of good soil, moistening
thoroughly with liquid manure, and subsequently
the entire mass in a similar way with earth and
kieserite, also deserves recommendation.

Bone Soup.

[Sent on from Lynn, Mass.]

Moisture at 100° C.,	
Dry matter,	
Nitrogen,	
Ash constituents,	

The liquid was obtained in rendering bones.
stituents consist mainly of common salt with a small
of bone phosphate, and its agricultural value depend
the nitrogen present. Allowing fifteen cents per p
element, one ton of the soup represents a value of
ought to be economized.

Dried Blood.

[Sent on for examination.]

Moisture at 100° C,	
Nitrogen (17 cents per pound)	
Valuation per 2,000 lbs.,	

Ammonium Sulphate.

[Sent on from Amherst, Mass.]

Moisture at 100° C.,	
Nitrogen 20.88 per cent.; equal to ammonia,	
Sulphuric acid,	

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Miscellaneous Analyses.

Examinations for Metallic Poisons.

samples of material have been sent for investigation. xaminations were made at the request of the Cattle ion of the State. The material sent consisted in these the stomach and some of the adjoining organs with ntents, besides the liver, bile and bladder of three Two of these specimens came from Ashfield and one field, Mass. In the first case — from Ashfield — there d a considerable quantity of copper, apparently due to of fine scraps of brass among the contents of the ; in the others no metallic poison could be detected. rth case came from Amherst, Mass. The material for ion consisted of the stomachs, with contents, of . A considerable quantity of arsenic acid was proved sent.

alyses of Maple Sap for Mineral Constituents.

from Goshen, Mass. I. Sample from an old tree, sp. gr., 1.015, at 23° C. II. Sample from a young tree, sp. gr., 1.010, at 23° C.]

	Parts per Thousand.	
	I.	II.
xide,	0.114	0.108
n oxide,	0.067	0.075
l,	0.029	0.026
of alkalies,	0.180	0.200

xamination was made to ascertain the relative amount present in both saps. The difference is but slight, as een from the above analyses.

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Analyses of Well Water, sent on for Examin

[Parts per Million.]

	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	So at re
I., ...	.32	.36	38.00	280.00	95.
II., ...	.09	.14	18.50	140.00	80.
III., ...	.14	.25	9.00	Not deter-	mi
IV., ...	.04	.17	56.00	Not deter-	mi
V., ...	.12	.16	12.00	.098	.
VI., ...	.05	.12	16.00	.126	.
VII., ...	.03	.08	3.00	.046	.
VIII., ...	.04	.06	5.00	.062	.
IX., ...	.12	.09	4.00	.134	.
X., ...	.04	.06	3.00	.136	.
XI., ...	.02	.08	5.00	.064	.
XII., ...	.014	.00	.06	–	.
XIII., ...	.01	.08	76.00	.280	.
XIV., ...	.004	.064	13 00	.092	.
XV., ...	.006	.056	14.50	.100	.
XVI., ...	.04	.07	4.00	.082	.
XVII., ...	.02	.093	22.00	.164	.
XVIII., ...	–	.102	7.00	.104	.
XIX., ...	.04	.07	4.00	.082	.
XX., ...	.02	.093	22.00	.164	.
XXI., ...	–	.102	7.00	.104	.

The above-stated results of analyses of drinking
obtained from samples sent on for that purpose fr
parts of the State. In most instances these reque
companied by a specified instruction regarding th
the party interested, — a circumstance which rende
of the chemist, comparatively speaking, an easy one.

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satisfactory supply of good drinking water on a farm de-
ls, in a controlling degree, on a judicious selection of the
ion of the well designed for the use of the family and for
live stock, and on the personal attention bestowed, from
to time, on the condition of the latter and its surround-
. Good wells are liable to change for the worse at any
, on account of circumstances too numerous to state in this
ection. To ascertain from time to time the exact condition
e well which supplies the wants of the family and of the
stock, is a task which no farmer can for any length of time
rd, without incurring a serious risk in health and pros-
y. The subject receives quite frequently but little atten-
on account of the fact that the harmful qualities which an
rently good water may contain are disguised beyond recog-
n by the unaided senses. Certain delicate chemical tests,
l at times by microscopical observations, are, in the major-
f cases, the only reliable means, in our present state of
tific inquiry, by which desirable information regarding the
character of a drinking water can be obtained.

ese tests, it must be acknowledged, although of the great-
nportance from a general standpoint, have their limitations.
readily indicate the presence of organic matters, but
no unfailing decision regarding their origin, — whether
al or vegetable, — leaving thus, quite frequently, the degree
eir harmfulness quite undecided. However, the chemical
sis may be depended upon for all practical purposes, as
ling the presence of objectionable qualities in the water.

e harmful substances found in drinking water are of two
es, — mineral and organic. Few natural waters are entirely
rom mineral matters; nearly all contain small quantities
ne, soda, magnesia and iron, — substances which may be
dered harmless in that case. Larger quantities of these
ents, however, render the water objectionable for drinking,
lso more or less unfit for various applications, as washing
ooking, feeding of steam apparatus, etc.

remost among the dangerous mineral substances which
been found in drinking water is lead. Its presence is
ly due to the use of lead-pipes for conducting the water
the well to the pump and elsewhere. Lead is a treacherous
dangerous poison. Not a trace should be tolerated in

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drinking water. The use of lead pipes for con
latter for any of the above-named purposes should b
discouraged.

The most frequent source of danger comes, evid
the presence of organic matter, indicating contamin
caying animal and vegetable substances. Wells ar
quently found polluted by the gases and liquids
from sinks, privies, cesspools or barnyards, when ap
ditions would seem to render it impossible.

Attention has already been called to this importa
a previous report; for one of the first requirement
on a farm consists in an ample supply of good wa
and towns usually have their organizations for t
water, and they exact certain guarantees regarding
furnished for their use. The farmer, living as a
isolated, is in this respect largely left to his o
Much has been written on this subject; yet, as t
for constant warning still remains, a restatement
facts cannot fail to assist in keeping the subject
consideration prominently before all parties conce
above-recorded analyses have been made according
lyn's process, familiar to chemists, and are dire
the indication of the presence of chlorine, free and
ammonia, and the poisonous metals. (For a m
description of this method see Water Analysis,
Wancklyn and E. T. Chapman.)

The hardness was determined by Frankland's me
Frankland's Water Analyses, page 29.)

The presence of chlorine indicates contamination
privies or sewers, since it occurs abundantly in ur
tions; but it may be derived from other and l
sources, as saline waters, which the test fails to ind
conclusion is, however, safe, — a water which conta
rine is uncontaminated by sewerage. "Free" an
noid" ammonia are forms in which organic matter is
Ammonia existing as such in water is termed "f
being expelled by distillation, the nitrogen-contai
matter remaining is reduced to ammonia by chemic
and this secondary product is called "albuminoid a

The per cent. of total solids is obtained by ev

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antity of the sample to dryness and weighing the

s, a rather arbitrary term, signifies that quality of ch prevents the ready formation of lather with soap. lly due to the presence of salts of lime or magnesia, ompose the soap, forming new insoluble compounds. these reactions occur no lather will be formed, con- the quantity of a standard soap consumed before a lather is obtained indicates the amount of earthy ined in the sample, or its relative degree of hard- ankland's scale has been changed to Clark's, the g a more popular one. Ten degrees of Frankland's quivalent to seven of Clark's.

ncklyn's interpretation of the results of his mode of on are as follows: —

rine alone does not necessarily indicate the presence ater.

and albuminoid ammonia in water without chlorine vegetable source of contamination.

than five grains per gallon of chlorine, accompanied han 0.08 parts per million of free ammonia and more enth part per million of albuminoid ammonia, is a ation that the water is contaminated with sewage, nimal matter, urine, etc., and should be condemned.

t hundredths part per million of free ammonia enth part per million of albuminoid ammonia render ry suspicious, even without much chlorine.

minoid ammonia over 0.15 parts per million ought ely condemn the water which contains it.

total solids found in the water should not exceed forty gallon.

mination of the above results of analyses shows that and 13 are of a suspicious character, and that Nos. 1, and 12 ought to be condemned.

sending on water for an analysis ought to be very use clean vessels, clean stoppers, etc. The sample sent on without delay after collecting. One gallon e for the analysis.

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METEOROLOGY.

The meteorological observations during the year been carried out on the same general plan as was 1885. The system is essentially the same as that rec to voluntary observers of the U. S. Signal Service. Annual Report.) The relative humidity has, howev tained only during the growing season; it was foun cable with our present facilities to run the " thermometer during the winter months. Our mont of observations have been forwarded regularly at possible date to the chief Signal Office during the e

The importance of weather observations to the St in connection with its field experiments, cannot b mated. The summaries, as they appear from time our bulletins and annual reports, are not without so to the farmers throughout the State. For the be farmers in our vicinity a more complete system of to indicate the expected changes in the weather wi duced during the coming season.

The more conspicuous local meteorological phenor past year (1886) consist in the early opening of the even distribution of the rainfall throughout the grow the absence of severe early or late frosts, and th rainfall during the autumn months. Only once summer, the first half of July, did the drought sufficient severity to injure vegetation, and then bu The first important snowfall of the year occurred (seven inches). Good sleighing was noticeable on vals throughout the remainder of the winter. The e "ice storms," so injurious to orchards and shade tre out the central part of the State, was not felt here. rainfall of February 10 to February 14 did no materi The total snowfall for the months of January, Fe March was 23.0 inches; on April 3, 0.5 inches of from the 5th to the 7th occurred a rain and snow st

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severity. The latest damaging frost was on April 30, st of the season occurred May 18, doing no material he season was, at the beginning of May, judging tate of the vegetation, at least two weeks in advance ieral average year.

owing table gives the temperatures and rainfall, ar- fortnightly periods, for the spring and fall months : —

	April, Last 15 Days.	May, First 15 Days.	May, Last 16 Days.	June, First 15 Days.	Aug., Last 15 Days.	Sept., First 15 Days.	Sept., Last 15 Days.	Oct., First 15 Days.
tion.								
3 years, .	1.73 in.	2 06 in.	1.86 in.	1.81 in.	2.02 in.	1.46 in.	1.84 in.	1.89 in.
. .	1.78 in.	1.01 in.	2.07 in.	1.61 in.	3.45 in.	0.69 in.	1.01 in.	1.68 in.
. .	0.10 in.	2.73 in.	0.37 in.	0.88 in.	1.63 in.	0.51 in.	4.97 in.	0.10 in.
ture.								
years, .	48.6°	57.0°	60.4°	64.9°	67.5°	64.3°	58.0°	52.4°
. .	51.6°	46.9°	61.1°	60.7°	63.2°	59.9°	52.9°	49.1°
. .	57.7°	55.7°	58.5°	61.8°	66.0°	62.9°	56.1°	52.2°

t frost of the fall occurred September 2; but little as done. Other light frosts followed September 14, The first killing frost came October 3; on the 17th d was frozen to the depth of one inch, and the thermometer registered 17° F. The first snow of of 1886 and 1887 came November 13, amounting to during December there was a fall of 16 inches, total of 40.5 inches for the entire year.

vailing direction of the wind, as taken from the ummaries, gives 29.2 per cent. from the northwest, ent. from the south, 20.9 per cent. from the north, 8.3 from the southwest, and 8.3 per cent. from the west. snow fell in measurable quantities on 122 days. The umber of such days in any one month was sixteen, in , and the fewest was six, in April.

ear" days, *i. e.*, those on which the sky was less tenths overcast at each observation, numbered 104, of had the greatest, thirteen; and April the fewest, four.

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The "cloudy days," or those on which the sky
than seven-tenths obscured at each observation, w
seven in number, of which January, March and De
the greatest, eleven each; and August fewest, two
ance of the year, 174 days, was "fair," with the sk
to seven-tenths obscured at each observation.

The highest temperature recorded throughout t
95.0°, occurring July 6; and the lowest — 22.0°,
and 14, giving as the absolute range of temperat
year 117.0°.

Miscellaneous Phenomena. — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.
January, . . .	2, 14, 15, 16.	9, 18, 19, 24, 30.	4, 5, 18, 19, 21, 27, 28, 29, 30	-
February, . . .	1, 15, 17, 18, 19.	21, 22, 25, 26.	11, 12, 13, 15, 19, 25, 26.	-
March, ...	6, 7, 17, 18.	8, 9, 12, 19, 21, 22.	13, 21, 27, 29.	-
April, ...	2, 9, 30.	3.	5, 6, 7, 13, 19, 24, 27.	-
May, ...	1, 18.	-	4, 5, 7, 8, 10, 11, 13, 15, 16, 20, 25.	20.
June, ...	-	-	2, 3, 13, 14, 15, 16, 17, 23, 24, 25, 26.	25, 26.
July, ...	-	-	10, 14, 15, 16, 17, 18, 21, 26, 27, 29.	18, 27, 29.
August, . . .	-	-	1, 2, 5, 7, 14, 16, 30, 31.	30.
September, . . .	2, 14, 21, 22.	-	12, 13, 15, 16, 17, 19, 22, 23, 25, 26, 27, 28, 29.	17, 28.
October, . . .	2, 3, 17, 22, 24.	-	14, 15, 17, 18, 26, 27, 28, 29, 30, 31.	-
November, . . .	5, 8, 9, 16, 26, 27, 28, 29.	13, 25.	6, 7, 10, 12, 13, 17, 18, 22, 23, 25, 30.	-
December, . . .	10, 21, 23.	5, 7, 13, 15, 16, 17, 18, 23, 24, 25, 26, 27, 29, 30, 31.	12, 13, 17, 18, 31.	-

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	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . . .	17.7	26.0	21.9	21.9	31.2	16.5	14.7	56.0	5th	—22	13th, 14th	-	-	-	-	5.39	27th to 30th
February, . .	17.8	27.0	23.8	23.1	30.9	13.8	17.1	52.0	15th	—11	5th	-	-	-	-	3 94	11th to 13th
March, . . .	28 8	38.5	33.3	33.5	40.4	23.9	16.5	61.0	31st	—1	1st	-	-	-	-	3.31	19th
April, . . .	43.5	56.5	50.9	50.4	61.3	35.6	26.0	83 0	20th	20.0	11th	89.0	74 8	80 2	81 4	1.73	5th to 7th
May, . . .	50.3	66.0	56.3	57.3	70.6	45.3	25.3	82.0	23d	29.0	1st	93.9	72 4	87.5	84.6	3.10	7th to 8th
June, . . .	58.5	70.4	61.9	63.2	72.9	48.9	24.0	82.0	21st	40 0	1st	94.0	71.5	84.2	83.2	2.33	23d to 25th
July, . . .	63.3	78.2	70.0	68.8	80.8	55 2	25.6	95.0	6th	40.1	12th	90.7	59.6	81.7	77.4	3.82	14th to 17th
August, . . .	60.4	77.1	63.8	66.3	79.0	53.4	25.6	90.0	27th	38.0	23d	91 2	59.7	81.2	77.4	2.60	30th to 31st
September, . .	53.6	69.3	57.5	59.5	70.4	46.7	23 7	83.8	9th	31.6	21st	93.6	58 7	87 3	70.4	5.48	27th to 29th
October, . . .	41.9	58 1	47.8	48.9	59.0	37.4	11 6	77.9	9th	17.0	17th	90.4	62.6	79.4	77.3	2.97	26th to 30th
November, . .	34.4	44.5	37.1	38.3	47.6	28 5	19.1	65.5	2d	15 9	28th	-	-	-	-	5.26	17th to 18th
December, . .	19 3	27.1	22.8	23.0	30.3	13.7	16.6	49 0	11th	0.8	30th	-	-	-	-	3.61	30th to 31st
Sums and means, .	40.8	53.2	45.6	46.2	56.2	34.9	20.5	73.1	-	16.5	-	*91.8	*65.6	*83.1	*78.8	43 54	-

* Means of 7 months.

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Record

Of the Average Temperature taken from Weather Record
Mass., for three consecutive months, during the summe
beginning with the year 1836.

December, January, February.		June, July, Aug	
1836–37, . . .	25.396° F.	1837, . . .	
1837–38, . . .	26.386°	1838, . . .	
1838–39, . . .	25.950°	1839, . . .	
1839–40, . . .	20.626°	1840, . . .	
1840–41, . . .	23.146°	1841, . . .	
1841–42, . . .	28.516°	1842, . . .	
1842–43, . . .	23.460°	1843, . . .	
1843–44, . . .	21.320	1844, . . .	
1844–45, . . .	25.550°	1845, . . .	
1845–46, . . .	22.140°	1846, . . .	
1846–47, . . .	25.176°	1847, . . .	
1847–48, . . .	28.966°	1848, . . .	
1848–49, . . .	23.026°	1849, . . .	
1849–50, . . .	27.570°	1850, . , .	
1850–51, . . .	25.040°	1851, . . .	
1851–52, . . .	21.620°	1852, . . .	
1852–53, . . .	27.940°	1853, . . .	
1853–54, . . .	23.670°	1854, . . .	
1854–55, . . .	23.126°	1855, . . .	
1855–56, . . .	20.820°	1856, . . .	
1856–57, . . .	22.720°	1857, . . .	
1857–58, . . .	26.956°	1858, . . .	
1858–59, . . .	24.746°	1859, . . .	
1859–60, . . .	24.790°	1860, . . .	
1860–61, . . .	24.510°	1861, . . .	
1861–62, . . .	24.470°	1862, . . .	
1862–63, . . .	27.640°	1863, . . .	
1863–64, . . .	26.060°	1864, . . .	
1864–65, . . .	21.310°	1865, . . .	
1865–66, . . .	25.676°	1866, . . .	
1866–67, . . .	25.276°	1867, . . .	
1867–68, . . .	20.350°	1868, . . .	

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Record of Temperature, etc. — Concluded.

ember, January, February.		June, July, August.	
. . .	26.290° F.	1869, . . .	66.890° F.
. . .	27.866°	1870, . . .	71.700°
. . .	26.666°	1871, . . .	67.810°
. . .	24.630°	1872, . . .	70.790°
. . .	21.350°	1873, . . .	68.596°
. . .	27.286°	1874, . . .	66.306°
. . .	21.180°	1875, . . .	68.026°
. . .	28.156°	1876, . . .	71.780°
. . .	23.510°	1877, . . .	70.080°
. . .	28.506°	1878, . . .	68.896°
. . .	24.290°	1879, . . .	68.150°
. . .	30.506°	1880, . . .	69.286°
. . .	21.856°	1881, . . .	67.966°
. . .	29.256°	1882, . . .	69.866°
. . .	24.220°	1883, . . .	68.840°
. . .	26.506°	1884, . . .	68.960°
. . .	22.630°	1885, . . .	66.740°
. . .	24.846°	1886, . . .	66.100°

Summary

Average Temperature from 1836 to 1862 (25 years).

ember, January, February.	June, July, August.
24.53° F.	68.26° F.

Summary

Average Temperature from 1862 to 1887 (25 years).

mber, January, February.	June, July, August.
25.21° F.	68.53° F.

eful study of the above tables cannot fail to show that age temperature of the three leading months during and winter seasons has not materially changed during ifty years,— a fact not generally conceded.

C. A. GOESSMANN,
Director.

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JAMES P. LYNDE, *Treasurer, in Account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1886.		*Receipts.*		1886.		*Expenditures.*	
Jan.	1,	Cash in Bank,	$840 79			Salaries,	$3,149 75
	2,	State Treasurer,	2,500 00			Laboratory Supplies,	975 76
	12,	C. A. Goessmann, Director,	281 79			Printing and Postage,	591 86
April	3,	State Treasurer,	2,500 00			Office Expenses,	171 97
	13,	C. A. Goessmann, Director,	61 55			Farmer and Farm Labor,	1,548 36
July	6,	State Treasurer,	2,500 00			Farm Supplies,	812 16
	13,	C. A. Goessmann, Director,	59 01			Stock and Feed,	450 86
Oct.	1,	State Treasurer,	2,500 00			Miscellaneous Expenses,	388 93
						Fitting up Buildings,	2,617 35
						Expenses Board of Control,	135 15
						Cash in Bank Jan. 1, 1887,	400 99
			$11,243 14				$11,243 14

Examined, compared with the vouchers, and found correct.

ALVAN BARRUS,
Auditor of the Board of Control.

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FIFTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE

CULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1887.

BOSTON:
GHT & POTTER PRINTING CO., STATE PRINTERS,
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18 POST OFFICE SQUARE.
1888.

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MASSACHUSETTS STATE

ICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1887.

HIS EXCELLENCY OLIVER AMES.

Governor of the Commonwealth, President ex officio.

NDE, ... Athol.
BARRUS, ... Goshen.

Appointed by the State Board of Agriculture.

ARE, ... Marblehead.
EMOND, ... Northampton.

ted by the Board of Trustees of the Massachusetts Agricultural College.

PPLETON, ... Boston.

ppointed by the Massachusetts Society for Promoting Agriculture.

OODELL, ... Amherst.

President of the Massachusetts Agricultural College.

ERS APPOINTED BY THE BOARD OF CONTROL.

BARRUS, *Secretary of the Board*, ... Goshen.
NDE, *Treasurer of the Board*, ... Athol.
DESSMANN, Ph. D., *Director and Chemist*, . . Amherst.

ASSISTANTS.

HEELER, B. S.,* . . *General and Analytical Chemistry.*
LLEN, B. S., . . . " " "
ELPS, B. S.,† . . . " " "
EAL, A. B., . . . " " "
INT, B. S., . . . " " "
ARPENTER, B. S., . . " " "
IORSE, B. S., . . . " " "
ALDWELL, B. S., . . *Field Experiments and Stock-feeding.*
VENTZELL, . . . *Farmer.*

* Left July 1, 1887. † Left April 1, 1887.

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BOSTON, Jan. 11, 1888.

orable the Governor and Council, State of Massachusetts.

ordance with the law of the State, I have the honor
nt the Fifth Annual Report of the Board of Control
tate Agricultural Experiment Station.

ALVAN BARRUS,
Secretary.

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FIFTH ANNUAL REPORT

OF THE

CTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

Honorable Board of Control.

NTLEMEN: — The advantages expected from a better in the chemical laboratory, the feeding department e field have been fairly realized during the past year. examinations carried on in the laboratory have been varied and more numerous; the feeding experiments received deservedly an increased attention; and the ment of fields for definite lines of investigation has advanced wherever circumstances have advised that .

laboratory building is in a good state of repair. The of new apparatus has been regulated by the means disposal for that purpose. Much has been accomd in that way; more still remains to be done to meet onstant demands, arising partly from an unavoidable ction of apparatus and partly from new inquiries into intricate subjects of animal and vegetable economy.

stalls lately built for a better accommodation of , cattle and swine have been completed according to s. Ample provisions have been made to supply them ot and cold water when needed. A new milk-setting and an ice-house have just been finished to complete tfit for observations concerning the products of the Some additional plain structures will be needed beng, to provide rooms for experiments with sheep and g cattle.

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The barn and adjoining sheds are well preserve parts of them have been transformed into a balanc feed room, a seed room, a tool room and worksho office, aside from some root pits and silos.

The dwelling-house of the farmer is, as far a stances permit, in a satisfactory condition. The bui soon need, however, in common with some of the buildings, a new coat of paint.

The work in the field has been greatly increased, quence of the recent addition of an area of thirt land. These lands are located on the east side of way, and consist of ten acres of wood land and acres of worn-out grass land. Twelve acres of which had been underdrained, graded and plough the preceding year, were utilized during the past the raising of potatoes, corn, horse bean, squashes barley. Most of the crops succeeded fairly, wh suffered seriously from frequent and heavy rainf the months of July and August. The lower p portion of the lands, about four acres in size, seeded down into a permanent meadow. The will be again planted with some general farm cro vate it, by drill cultivation, for future experime remaining eight acres of old grass land have been e underdrained during the latter part of the autumn sequently ploughed. These lands are designed ultimately in part for the cultivation of general and for a fruit orchard for experimental purposes.

The lands located on the west side of the high been resurveyed, and the outlines of each experim marked by painted gas pipes; the latter are burie in the soil, to prevent the shifting of the markers an the farmer as future guides in ploughing, etc. area of ploughed land is divided into four disti named A, B, C, D, of which there is a complete their past history.

The experimental work carried on in the barn and the laboratory of the Station during the pa described in the subsequent pages under the headings :—

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Experiments with milch cows; English hay, corn fodder, fodder ilage, roots, etc.
Experiments with milch cows; with green fodder, vetch and ithern cow pea, serradella, etc.
Experiments with pigs; with skim-milk, corn meal, gluten meal, at bran.
On fodder supply and analyses of fodder articles.
Fodder corn raised with single articles of plant food.
Fodder crops raised with and without complete manure.
Experiments with wheat, vetch and oats, serradella, and Southern .
Experiments with potatoes, roots, and miscellaneous crops.
Suggestions upon planting trees and small fruits, by Prof. S. T l.
Fertilizer and fertilizer analyses; miscellaneous analyses.
Well-water analyses.
Compilation of analyses of fodder articles with reference to food
Compilation of analyses of fodder articles with reference to g ingredients.
Compilation of analyses of agricultural chemicals and refuse s used for fertilizing purposes.
Meteorological observations.

n the previous enumeration of subjects reported on, be noticed that some of them are reports of progress, ng questions for one or two years already under in- tion; while others are new additions to the work d.

feature in the communications on experimental work natural when remembering that one year's observation work does only in exceptional cases entitle to a final ion.

e compilations of our previous analyses of fodder , agricultural chemicals and refuse material from branches of industry have been added for the pur- placing permanently on record for reference certain oncerning these materials. These abstracts cannot se but prove acceptable to the farmers of the State. tabular statement of the extremes of temperature at t, Mass., from the year 1836 to 1888, has been pre- t the special request of the U. S. Forestry depart-

periodical publications of the Station have been as us as in previous years. The interest in the bulletins

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and annual reports has been steadily growing
past year. The number of bulletins printed has l
from 5,000 in 1886 to 6,000 in 1887, and will be i
7,000 early in the coming season.

It gives me particular pleasure to bear testim
satisfactory support I have had from all parties en
me in the work of the Station.

In conclusion permit me to thank you very si
the liberal support I have enjoyed in performing
assigned to me.

Yours very respectfully,

C. A. GOESSMA

Director of the State Agricultural Experim

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ON FEEDING EXPERIMENTS.

Feeding Experiments with Milch Cows; English Hay, Corn Fod-
'odder Corn, Ensilage, Roots, etc.

Feeding Experiments with Milch Cows; with Green Fodder,
and Oats, Southern Cow Pea, Serradella, etc.

. Feeding Experiments with Pigs; Skim-milk, Corn Meal, Gluten
and Wheat Bran.

I. Feeding Experiments with Milch Cows.

e feeding experiments with milch cows reported within
v subsequent pages are essentially a continuation of
described in the fourth annual report of the Station
6–1887). To compare the feeding effect of dried fod-
orn, corn fodder (stover), and corn ensilage as a sub-
te, in whole or in part, for English hay, and that of corn
age as compared with that of roots, under otherwise
sponding circumstances, has been the principal object
r work on both occasions.

e same fodder articles have been used in both trials,
the exception that in the experiments discussed below
ts have been taken instead of sugar beets, which were
in the preceding year. Aside from this temporary
fication in the diet, a comparatively new fodder article,
luten meal, has been added as a temporary ingredient
e daily fodder ration. This particular change in the
osition of the feed used was made for the purpose of
ring, whenever desired, a closer numerical relation be-
n the digestible nitrogenous and non-nitrogenous or-
c constituents of the food consumed as compared with
which served in our previous experiments. The gluten
was chosen from among the various concentrated com-

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mercial feed-stuffs on account of its close relatio
of which it constitutes a part, and its higher ni
character when compared with that of the corn me
wheat bran (shorts).

Three cows, mixed breed, from five to six years
selected for our work. They were practically in
milking period, from three to six weeks after calvi
beginning of the trial. The observation extend
period of seven months, — October 1, 1886, to
1887.

The temporary changes in the diet, wherever
upon, were carried out gradually, as it is custom
carefully conducted feeding experiments. At least
are allowed in every instance to pass by, in case of
in the character of the feed, before the daily obser
the results appear in our published records.
which accompany all detailed reports of our feedi
ments, past and present, furnish exact figures in
tion. This is, in particular, the case whenever s
ments are of a special interest, for an intelligent ap
of the final conclusions presented.

As our feeding experiments with milch cows w
nally undertaken with the intention of carrying
tematic course of inquiry into the economical re
the production of milk with reference to the dairy
as well as to a practical general farm manageme
thought best, for various reasons, to begin our
cows of moderate milking qualities. The effect o
diets on the quantity and quality of the milk pro
well as their bearing on the net cost of production,
to be of particular interest under the stated circu
A beginning of our work at the lower end of the s
production of milk offered besides, the particular
that the results obtained, by a careful mode of ob
might find a direct application to a still quite nume
of cows on our farms, which are not infrequentl
to be of but little merit from an economical standpo
our intention to publish, as soon as practicable, a
concerning the annual yield of milk of some of o
present on trial, and also the net cost of its prod

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s the feed is concerned, to show more plainly the annual ts of keeping cows of moderate milking qualities.

e daily diet of the cows consisted, at the beginning of experiments, of three and one-quarter pounds of corn , an equal weight of wheat bran, and all the hay they l eat. The actual amount of hay consumed in each case ascertained by daily weighing out a liberal supply of it, leducting subsequently the hay left over.

e statement in our records below refers to the average mption of hay per day during the feeding period.

e above stated combination of fodder articles was ted as the basis of our investigation mainly for the n that it had been used with satisfactory results in of our earlier feeding experiments, and not on the nption of its being the best possible combination of r articles for milch cows. The weights of the animals taken on the same day of each week before milking feeding.

e valuation of the various fodder articles consumed is l on the local market price per ton in Amherst when used.

English hay, .	$15.00.	Rye middlings, . .	$24.00.
meal, . . .	23.00.	Dry corn fodder (stover),	5.00.
t bran, . . .	20.00.	Corn ensilage, . .	2.75.
n meal, . . .	23.00.	Carrots, ...	7.00.

e *value* of a fodder for dairy purposes may be stated *two distinctly different standpoints;* namely, with ref- e to its *influence on the temporary yield of milk* and *eneral condition of the animals* which consume it, and gard to its *first cost*, — i. e., its *physiological* and *com- al value.*

e market value and the actual feeding effect of one and same article do not necessarily correspond with each ; in fact, they rarely coincide.

e market value may be stated for each locality by one ite number. The feeding effect of one and the same ance, simple or compound, *varies* under *different cir- tances*, and depends in a controlling degree on its *judi- use in compounding diets.*

no single plant or part of plant has been found to sup- conomically and efficiently, to any considerable extent,

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the wants of our various kinds of farm stock, it b
matter of first importance to learn how to supple
leading farm crops to meet the divers wants of e
To secure the highest feeding value of each article
is most desirable in the interest of good economy.
cious selection of ingredients for a suitable and rem
diet for our dairy stock obliges us, therefore, to
value of the fodder articles at our disposal from bo
points.

The chemical analyses of the various articles us
combination of fodder in our case are stated in s
ceeding pages to show their character and their r
quality. To ascertain the chemical composition of
ration, in connection with an otherwise carefully
feeding experiment, enables us to recognize with
tainty the causes of the varying feeding effects of
the same fodder article when fed in different coml
It furnishes, also, a most valuable guide in the sel
suitable *commercial feed stuffs* from *known sources* t
ment economically our home-raised fodder crops.
experience in feeding stock has so far advanced that
to need no further argument to accept it as a matte
that the efficiency of a fodder ration in the dairy
depend, aside from its general or special adaptatio
mere presence of more or less of certain prominer
articles, but on the presence of a proper quanti
certain relative proportion of certain prominent co
of plants, which are known to be essential for a s
support of life and of the special functions of the d

Investigations into the relations which the variou
nent constituents of plants bear to the support o
life have rendered it advisable to classify them, in
nection, into *three* groups, — *mineral constituents*, ar
enous and *non-nitrogenous organic constituents*. Fo
regarding this matter I have to refer to previous pu
of the Station. (See Fourth Annual Report, pages
Numerous and extensive practical feeding experim
most of our prominent fodder articles in various co
and with all kinds of farm live stock, have introd
practice of reporting, in connection with the analys

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t, also, the result of careful feeding experiments, as the various fodder articles have proved digestible, and hus qualified for the support of the life and the func- of the particular kind of animal on trial. In stating ount of the digestible portion of the fodder consumed eding experiment, it has proved useful, for comparing nt fodder rations, etc., to make known by a distinct the relative proportion which has been noticed to etween the amount of its digestible nitrogenous and trogenous organic constituents. This relation is ex- d by the name of "Nutritive Ratio." An examination subsequent short description of our feeding experi- will show, for instance, that the corn meal fed con- one part of digestible nitrogenous to 8.76 parts of ble non-nitrogenous organic matter, making the cus- allowance for the higher physiological value of the compared with that of starch, sugar, etc. (2.5 times). The "Nutritive Ratios" of the articles of feed ned are subsequently stated, as follows: —

eal, . . .	1 : 8.76.	English hay, . .	1 : 9.5.
oran, . .	1 : 3.47.	Dry corn fodder, . .	1 : 9.3.
meal, . .	1 : 2.67.	Corn ensilage, . .	1 : 11.9.
ddlings, . .	1 : 7.28.	Carrots, . . .	1 : 9.24.

results of our own analyses of these fodder articles e turned to account for the calculation of the above "Nutritive Ratios."

s been noticed that, as a general rule, growing ani- nd milch cows require a richer food, i. e., a closer n of digestible nitrogenous and non-nitrogenous constituents in their feed, to do their best, than full- animals and moderately worked horses or oxen. n investigators recommend a combination of fodder , in other respects suitable, which contains one part estible nitrogenous organic constituents to 5.4 parts of ble non-nitrogenous constituents.

n the description of our earlier feeding experiments nilch cows (see Fourth Annual Report, page 11), it observed, that the relations of the digestible nitroge- nd non-nitrogenous organic constituents in the different nations of fodder articles which constituted, during the

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various feeding periods, the daily diet of the cow
that occasion from 1 : 6.7 to 1 : 10.17. The clo
was obtained by feeding on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1

And the wider ratio by feeding daily on an avera

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1

(See Daisy.) During our more recent feed
ments described below, on the whole, closer r
adopted than before. The relations between the
stated important groups of fodder constituents
1 : 5.9 to 1 : 7.9; they are also more uniform
various feeding periods. The closer relation is
feeding daily on an average, —

3¼ lbs. of corn meal,* 3¼ lbs. of wheat bran,* 3¼ lbs. of gluten meal, 10 lbs. of hay, 35 lbs. of carrots,	Nutritive ratio, 1 : 5.

and the wider ratio by feeding daily on an averag

3¼ lbs. of corn meal, 3¼ lbs. of wheat bran, 25 lbs. of hay,	Nutritive ratio, 1 : 7.

(See Dora.) The entire recent feeding experi
subdivided into eight distinctly different feeding
same number as on the preceding occasion, fo
length of time, — seven months.

The dry corn fodder, the ensilage and the roo
before being offered as feed. The exact amoun
of each fodder article was ascertained by taking th
before feeding and deducting the amount left, if a
and roots were usually fed during milking, and
fodder between times.

* 3¼ lbs. of wheat bran is equal to four quarts; and 3¼ lbs. of cor
to two quarts.

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eful examination of our subsequently tabulated feed-
rds of each cow (Susie, Meg and Dora), leads appar-
th much propriety, among others, to the following
ons : —

utritive value of our dry corn fodder compares well
t of an average quality of English hay; the same
said of good corn ensilage in place of from one-half
hirds of the customary amount of hay.

utritive value of our dry corn fodder (stover) and of
corn ensilage, taking into consideration pound for
f the dry vegetable matter they contain, has proved
ase fully equal, if not superior, to that of the average
hay.

utritive feeding value of carrots, taking into consid-
pound for pound of the dry matter they contain, ex-
at of the corn ensilage as an ingredient of the daily
place of a part (one-half) of the hay fed. The
ons thus far stated are in full agreement with those
out in our earlier experiments.

nfluence of the *various diets* used, on the *quality* of
, seems to depend in a controlling degree on the
ional characteristics of the animal on trial. The
not unfrequently in our case the reverse in different
depending on the same diet.

ield of the milk decreased, although at a different
the case of different animals as time advanced.
inkage in the daily yield of milk amounted, at the
e entire experiment, to from 3.2 quarts to 4.9 quarts
f different cows. The gradual decline in the entire
ord of every cow is only once broken; namely, dur-
sixth feeding period, Feb. 7th to Feb. 21st, when
of milk shows an increase of from .7 to 1.9 quarts
, as compared with that of the preceding period.
nge for the better was noticed when ten pounds of
thirty-four pounds of carrots were used, under other-
rresponding circumstances, as a substitute for five
f hay and twenty-nine pounds of corn ensilage; the
of dry vegetable matter contained in the hay fed
ts and in the hay fed with corn ensilage was prac-
e same in both instances. The feed of the sixth

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feeding period, containing carrots as an ingredien
most nutritive and also the most expensive.

The total cost of the feed consumed for the p
milk is lowest wherever corn fodder or corn e
replaced, in the whole or in part, English hay,
wise corresponding circumstances.

The net cost of feed consumed for the produ
quart of milk, during the various feeding perio
widely as from .34 cents to 1.6 cents in case
cow. The net cost of the feed is obtained by
per cent. of the value of the fertilizing co
contains.

The manurial value of the feed consumed du
tire feeding experiment, deducting 20 per c
amount of fertilizing constituents lost in the p
milk, is, at current market rates, in every instan
equal to one-third of the original cost of the fee

Two cows gained from 60 to 66 pounds in
during the trial; and one—the best milker, Dor
tically her own from beginning to end.

For further details see the following page
misconstruction regarding the statement of net
used in our description, I state once more tha
include expenses for labor, housing, interest on
etc., but means merely net cost of feed after d
per cent. of its manurial value.

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FEEDING PERIODS.	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1886.													
1. Oct. 1 to 25,	3.25	3.25	–	–	24.92	–	–	–	28.59	13.5	2.11	1 : 7.9	855
2. Nov. 1 to 16,	3.25	3.25	3.25	–	19.03	–	–	–	26.15	13.2	1.98	1 : 6.1	877
3. Dec. 6 to 13,	–	3.25	3.25	3.25	20.00	–	–	–	27.65	11.8	2.35	1 : 6.8	883
4. Dec. 21 to 31,	3.25	3.25	–	–	–	–	21.36	–	23.81	11.9	2.00	1 : 7.7	888
1887.													
5. Jan. 18 to 31,	3.25	3.25	3.25	–	5.00	32.79	–	–	22.60	11.0	2.06	1 : 6.4	897
6. Feb. 7 to 21,	3.25	3.25	3.25	–	10.00	–	–	35.00	21.36	12.9	1.66	1 : 5.9	914
7. Mar. 9 to 25,	3.25	3.25	3.25	–	20.00	–	–	–	27.00	11.1	2.42	1 : 6.2	951
8. Apr. 6 to 24,	3.25	3.25	3.25	–	18.95	–	–	–	26.07	9.4	2.76	1 : 6.1	1,019

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MEG: Age, Six Years; Grade, Devon; Last Calf, Aug. 2, 1886.

Feeding Periods.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).					
1886.													
1. Oct. 1 to 25,	3.25	3.25	–	–	25.00	–	–	–	28.66	13.9	2.06	1 : 7.9	1,023
2. Nov. 1 to 16,	3.25	3.25	3.25	–	19.34	–	–	–	26.44	13.2	2.00	1 : 6.1	1,049
3. Dec. 6 to 13,	–	3.25	3.25	3.25	20.00	–	–	–	27.65	12.9	2.15	1 : 6.8	1,078
4. Dec. 21 to 31,	3.25	3.25	–	–	–	–	17.59	–	20.62	12.0	1.72	1 : 7.5	1,023
1887.													
5. Jan. 18 to 31,	3.25	3.25	3.25	–	5.00	25.25	–	–	20.46	10.3	1.98	1 : 6.1	1,055
6. Feb. 7 to 21,	3.25	3.25	3.25	–	10.00	–	–	35.00	21.36	11.0	1.94	1 : 5.9	1,083
7. Mar. 9 to 25,	3.25	3.25	3.25	–	20.00	–	–	–	27.00	10.9	2.50	1 : 6.2	1,087

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FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.												
	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1886.													
1. Oct. 1 to 25,	3.25	3.25	–	–	23.00	–	–	–	26.86	16.3	1.65	1 : 7.8	882
2. Nov. 1 to 16,	3.25	3.25	3.25	–	17.70	–	–	–	24.92	15.7	1.59	1 : 6.0	859
3. Dec. 6 to 13,	–	3.25	3.25	3.25	20.00	–	–	–	26.98	14.6	1.85	1 : 6.8	889
4. Dec. 21 to 31,	3.25	3.25	–	–	–	–	19.77	–	22.46	14.0	1.60	1 : 7.7	851
1887.													
5. Jan 18 to 31,	3.25	3.25	3.25	–	5.00	28.64	–	–	21.42	12.8	1.68	1 : 6.2	856
6. Feb. 7 to 21,	3.25	3.25	3.25	–	10.00	–	–	35.00	21.36	13.5	1.58	1 : 5.9	855
7. Mar. 9 to 25,	3.25	3.25	3.25	–	20.00	–	–	–	27.00	12.2	2.21	1 : 6.2	836
8. Apr. 6 to 24,	3.25	3.25	3.25	–	18.95	–	–	–	26.07	11.7	2.23	1 : 6.1	877

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Total Cost of Feed per Quart of Milk.

(SUSIE.)

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	338.6	13.5	81.25	81.25	–	–	623.0	–	–	–	$6 41	1.89
2. Nov. 1 to 16,	211.3	13.2	52.00	52.00	52.00	–	304.5	–	–	–	4 00	1.89
3. Dec. 6 to 13,	94.0	11.8	–	28.00	28.00	28.00	160.0	–	–	–	2 18	2.31
4. Dec. 21 to 31,	130.5	11.9	35.75	35.75	–	–	–	–	235.0	–	1 36	1.04
1887.												
5. Jan. 18 to 31,	153.3	11.0	45.50	45.50	45.50	–	70.0	459.0	–	–	2 66	1.74
6. Feb. 17 to 21,	193.5	12.9	48.75	48.75	48.75	–	150.0	–	–	525.0	4 58	2.37

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FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	347.8	13.9	81.25	81.25	–	–	625.0	–	–	–	$6 43	1.85
2. Nov. 1 to 16,	211.0	13.2	52.00	52.00	52.00	–	809.5	–	–	–	4 04	1.91
3. Dec. 6 to 13,	103.0	12.9	–	28.00	28.00	28.00	160.0	–	–	–	2 18	2.12
4. Dec. 21 to 31,	132.0	12.0	35.75	35.75	–	–	–	–	193.5	–	1 25	.95
1887.												
5. Jan. 18 to 31,	144.5	10.3	45.50	45.50	45.50	–	70.0	353.5	–	–	2 51	1.74
6. Feb. 7 to 21,	165.5	11.0	48.75	48.75	48.75	–	150.0	–	–	525.0	4 57	2.76
7. Mar. 9 to 25,	184.0	10.9	55.25	55.25	55.25	–	340.0	–	–	–	4 38	2.38
8. Apr. 6 to 24,	203.3	10.7	61.75	61.75	61.75	–	360.0	–	–	–	3 84	1.90

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Total Cost of Feed per Quart of Milk.

(DORA.)

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	408.0	16.3	81.25	81.25	–	–	576.0	–	–	–	$6 05	1.48
2. Nov. 1 to 16,	251.5	15.7	52.00	52.00	52.00	–	283.0	–	–	–	3 84	1.53
3. Dec. 6 to 13,	116.5	14.6	–	28.00	28.00	28.00	160.0	–	–	–	2 18	1.87
4. Dec. 21 to 31,	154.0	14.0	35.75	35.75	–	–	–	–	217.5	–	1 31	.85
1887.												
5. Jan. 18 to 31,	179.0	12.8	45.50	45.50	45.50	–	70.0	401.0	–	–	2 58	1.44
6. Feb. 7 to 21,	203.0	13.5	48.75	48.75	48.75	–	150.0	–	–	525.0	4 58	2.26

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mary of Net Cost of Feed for each Cow during succeeding Periods.

RIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
, . . .	$6 41	$2 72	$2 18	$4 23	1.24	861
. . .	6 43	2 72	2 18	4 25	1.22	1,030
, . . .	6 05	2 58	2 06	3 99	.98	860
, . . .	4 00	1 92	1 54	2 46	1.16	896
. . .	4 04	1 92	1 54	2 50	1.18	1,055
, . . .	3 84	1 85	1 48	2 36	.94	876
, . . .	2 18	92	74	1 44	1.53	883
. . .	2 18	92	74	1 44	1.40	1,056
, . . .	2 18	92	74	1 44	1.24	884
, . . .	1 36	1 00	80	56	.43	876
. . .	1 25	89	71	54	.41	1,020
, . . .	1 31	96	78	53	.34	844
, . . .	2 66	1 48	1 18	1 48	.97	905
. . .	2 51	1 39	1 11	1 41	.98	1,070
, . . .	2 58	1 43	1 14	1 44	.80	860
, . . .	4 58	1 67	1 34	3 24	1.67	921
. . .	4 58	1 67	1 34	3 24	1.96	1,096
, . . .	4 58	1 67	1 34	3 24	1.60	852
, . . .	4 38	2 09	1 67	2 71	1.43	967
. . .	4 38	2 09	1 67	2 71	1.47	1,101
, . . .	4 38	2 09	1 67	2 71	1.30	831
, . . .	3 84	2 27	1 82	2 02	1.13	1,060
. . .	3 84	2 27	1 82	2 02	.99	1,170
, . . .	3 84	2 27	1 82	2 02	.91	885

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Summary.

SUSIE.

Total amount of milk produced during above records,
Total cost of feed per quart of milk produced, . .
Manurial value left behind per quart of milk produced,
Net cost per quart of milk produced, ...

MEG.

Total amount of milk produced during above records, .
Total cost of feed per quart of milk produced, . .
Manurial value left behind per quart of milk produced,
Net cost per quart of milk produced, ...

DORA.

Total amount of milk produced during above records, .
Total cost of feed per quart of milk produced, . .
Manurial value left behind per quart of milk produced,
Net cost per quart of milk produced, ...

Manurial Value of Feed.

SUSIE.

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilising Constituents contained in the Feed.	Manurial Value of the Feed after deducting (by 30) per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.
1886.				
1. Oct. 1 to 25, .	$6 41	$2 72	$2 18	$4 23
2. Nov. 1 to 16, .	4 00	1 92	1 54	2 46
3. Dec. 6 to 13, .	2 18	92	74	1 44
4. Dec. 21 to 31, .	1 36	1 00	80	56
1887.				
5. Jan. 18 to 31, .	2 66	1 48	1 18	1 48
6. Feb. 7 to 21, .	4 58	1 67	1 34	3 24
7. Mar. 9 to 25, .	4 38	2 09	1 67	2 71
8. Apr. 6 to 24, .	3 84	2 27	1 82	2 02
Total, . .	$29 41	$14 07	$11 27	$18 14

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MEG.

NG PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1886.					Cents.	Lbs.
1 to 25, .	$6 43	$2 72	$2 18	$4 25	1.22	1,030
1 to 16, .	4 04	1 92	1 54	2 50	1.18	1,055
6 to 13, .	2 18	92	74	1 44	1.40	1,056
21 to 31, .	1 25	89	71	54	.41	1,020
1887.						
18 to 31, .	2 51	1 39	1 11	1 41	.98	1,070
7 to 21, .	4 58	1 67	1 34	3 24	1.96	1,096
9 to 25, .	4 38	2 09	1 67	2 71	1.47	1,101
6 to 24, .	3 84	2 27	1 82	2 02	.99	1,170
tal, . .	$29 21	$13 87	$11 11	$18 11	–	–

DORA.

1886.					Cents.	Lbs.
1 to 25, .	$6 05	$2 58	$2 06	$3 99	.98	860
1 to 16, .	3 84	1 85	1 48	2 36	.94	876
6 to 13, .	2 18	92	74	1 44	1.24	884
21 to 31, .	1 31	96	78	53	.34	844
1887.						
18 to 31, .	2 58	1 43	1 14	1 44	.80	860
7 to 21, .	4 58	1 67	1 34	3 24	1.60	852
9 to 25, .	4 38	2 09	1 67	2 71	1.30	831
6 to 24, .	3 84	2 27	1 82	2 02	.91	885
tal, . .	$28 76	$13 77	$11 03	$17 73	–	–

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Valuation of Essential Fertilizing Constituents cont
various Articles of Fodder Used.

Nitrogen, 17 cents per pound; Phosphoric acid, 6 cent
oxide, 4¼ cents.

(*Per cent.*)

	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.
Nitrogen, ...	2.80	1.96	5.03	1.84	1.21	0.36
Phosphoric acid, . .	2.36	0.77	0.30	1.26	0.36	0.14
Potassium oxide, . .	1.36	0.45	0.03	0.81	1.63	0.33
Valuation per 2,000 lbs.,	$13 51	$7 97	$17 49	$8 46	$5 93	$1 68

Analyses of Milk.

SUSIE.

(*Per cent.*)

	1886. Oct. 22.	Nov. 3.	Nov. 30.	Dec. 14.	Dec. 31.	1887. Jan. 19.	Jan. 31.	
Water, ...	88.10	87.66	87.21	87.16	88.23	87.75	87.27	8
Solids, ...	11.90	12.34	12.79	12.83	11.77	12.24	12.72	1
Fat (in solids), . . .	3.79	3.47	4.29	3.92	3.34	3.47	4.08	

MEG.

Water, ...	87.71	87.80	87.80	87.62	88.37	88.29	88.43	8
Solids, ...	12.29	12.20	12.20	12.38	11.63	11.71	11.57	1
Fat (in solids), . . .	3.69	3.36	3.30	3.64	3.16	2.98	3.11	

DORA.

Water, ...	87.75	87.14	87.18	87.45	87.00	86.84	87.10	8
Solids, ...	12.25	12.86	12.82	12.55	13.00	13.16	12.90	1
Fat (in solids), . . .	3.69	3.96	3.89	3.73	3.77	3.77	3.27	

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HAY.

[From Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
at 100° C., . . .	8.30	166.00	–	–	1 : 9.5
er, ...	91.70	1,834.00	–	–	
	100.00	2,000.00	–	–	
s of Dry Matter.					
n, ...	6.12	122.40	–	–	
llulose, . . .	30.19	603.80	350.20	58	
, ...	2.55	51.00	23.46	46	
otein (Nitrogenous Matter), . . .	9.75	195.00	111.15	57	
genous Extract	51.39	102.78	647.51	63	
	100.00	2,000.00	1,132.32	–	

DRY CORN FODDER (Stover).

[From Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
at 100° C., . . .	15.40	308.00	–	–	1 : 9.3
er, ...	84.60	1,692.00	–	–	
	100.00	2,000.00	–	–	
s of Dry Matter.					
h, ...	4.22	84.40	–	–	
llulose, . . .	20.93	418.60	301.39	72	
t, ...	2.63	52.60	39.45	75	
otein (Nitrogenous Matter), . . .	9.17	183.40	133.88	73	
genous Extract	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

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CORN ENSILAGE.

[From the Silos of the Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C., . . .	71.60	1,432.00	–
Dry Matter, ...	28.40	568.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash, ...	3.32	66.40	–
" Cellulose, ...	18.52	370.40	266.69
" Fat, ...	6.07	121.40	91.05
" Protein (Nitrogenous Matter), . . .	7.78	155.60	113.59
Non-nitrogenous Extract Matter, ...	64.31	1,286.20	861.75
	100.00	2,000.00	1,333.08

CARROTS.

[Raised at the Experiment Station, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C., . . .	90.02	1,800.40	–
Dry Matter, ...	9.98	199.60	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash, ...	11.21	224.20	–
" Cellulose, ...	10.76	215.20	215.20
" Fat, ...	1.89	37.80	37.80
" Protein (Nitrogenous Matter), . . .	8.90	178.00	178.00
Non-nitrogenous Extract Matter, ...	67.24	1,344.80	1,344.80
	100.00	2,000.00	1,775.80

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average amount of dry matter in well grown carrots
ally stated (E. Wolff) to be 15 per cent. of the weight
fresh root; in *our* case it varied from *9 to 12* per
according to the size of the root tested. Large speci-
of roots contain frequently a smaller amount of dry
ble matter than smaller ones equally matured. Cul-
n, manuring, season and time of seeding, aside from
of the soil, affect seriously the general character of
ot crops. In our case, soil and state of fertilization
favorable, — frequent rains towards the close of the
er season had favored apparently in an exceptional
the growth of the leaves at the expense of a timely
ng of the roots.

lysis of Carrots with reference to Fertilizing Constituents.

	Per cent.
e at 100° C.,	90.02
xide,	0.01
oric acid (6 cents per pound),	0.10
ium oxide,	0.02
n oxide,	0.07
um oxide (4¼ cents per pound),	0.54
oxide,	0.11
n (17 cents per pound),	0.14
le matter,	0.01
on per 2,000 pounds,	$1 06

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CORN MEAL.

[Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Di-
Moisture at 100° C.,	12.62	252.40	–	
Dry Matter,	87.38	1,747.60	–	
	100.00	2,000.00	–	
Analysis of Dry Matter.				
Crude Ash,	1.56	31.20	–	
" Cellulose,	2.66	53.20	18.09	34
" Fat,	4.27	85.40	64.90	76
" Protein (Nitrogenous Matter,	11.43	228.60	194.31	85
Non-nitrogenous Extract Matter,	80.08	1,601.60	1,505.50	94
	100.00	2,000.00	1,782.80	–

WHEAT BRAN.

[Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.
Moisture at 100° C.,	10.87	217.40	–	–
Dry Matter,	89.13	1,782.60	–	–
	100.00	2,000.00	–	–
Analysis of Dry Matter.				
Crude Ash,	5.90	118.00	–	–
" Cellulose,	8.27	165.40	33.08	20
" Fat,	4.40	88.00	70.40	80
" Protein (Nitrogenous Matter,	19.63	392.60	345.53	88
Non-nitrogenous Extract Matter,	61.80	1,236.00	988.80	80
	100.00	2,000.00	1,437.81	–

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RYE BRAN (MIDDLINGS).

[Amherst Mills.]

4.63 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.)	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
at 100° C.,	12.54	250.80	–	–	1 : 7.28
er,	87.46	1,749.20	–	–	
	100.00	2,000.00	–	–	
is of Dry Matter.					
sh,	4.02	80.40	–	–	
llulose,	3.70	74.00	6.66	9.0	
t,	5.61	112.20	64.52	57.5	
otein (Nitrogenous Matter),	13.15	263.00	173.58	66.0	
ogenous Extract,	73.52	1,470.40	1,095.45	74.5	
	100.00	2,000.00	1,340.21	–	

lysis of Rye Bran with Reference to Fertilizing Constituents.

ndred parts of air-dried Bran contained: —

	Per cent.
at 100° C.,	12.54
ric acid (6 cents per pound),	1.26
um oxide,	0.32
oxide,	0.09
ide,	0.02
n oxide, (4¼ cents per pound),	0.81
oxide,	0.03
(17 cents per pound),	1.84
e matter,	0.17
n per 2,000 pounds,	$8 46

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CHICAGO GLUTEN MEAL.

96.81 per cent. passed through Mesh 144 to sq

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of
Moisture at 100° C.,	8.83	176.60	–
Dry Matter,	91.17	1,823,40	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	0.73	14.60	–
" Cellulose,	0.79	15.80	5.
" Fat,	8.46	169.20	128.
" Protein (Nitrogenous Matter),	31.43	628.60	534.
Non-nitrogenous Extract Matter,	58.59	1,171.80	1,101.
	100.00	2,000.00	1,769.

The material is sold at Springfield, Mass., ton.

Analysis of Gluten Meal with reference to Fertilizing

Moisture at 100° C.,	
Phosphoric acid (6 cents per pound),	
Ferric oxide,	
Magnesium oxide,	
Calcium oxide,	
Potassium oxide (4¼ cents per pound),	
Sodium oxide,	
Nitrogen (17 cents per pound),	
Valuation per 2,000 pounds,	

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2. Feeding Experiments with Milch Cows.

ıe experiments were chiefly instituted for the purpose ɔmparing the feeding effect of a good English hay with of some reputed green fodders. The green crops used ıis connection consisted of a mixed crop of oats and ı, of southern cow-pea and of serradella. Some details rding the mode of cultivation and the general character ese fodder plants will be found farther on in this report, r the heading "Field Experiments."

ıe feeding of the various green fodders began at the time ıeir blooming; they were fed in succession as stated e, for they began to bloom in the order mentioned. feeding of vetch and oats ceased when the oats turned ɔw; that of the cow-pea and serradella terminated with xhaustion of the supply from the first cut.

ıe customary rules for the management of feeding riments, regarding the changes in feed, etc., were fol- d in the same manner as pointed out on previous occa- .

ve cows served in the experiment. Two cows, Ida and ie, were fed during the entire trial with a daily ration, isting of

Corn Meal, ...	3¼ pounds (2 quarts.)
Wheat Bran, ...	3¼ pounds (4 quarts.)
English Hay, ...	from 20 to 25 pounds.

ıe amount of hay left over was each day weighed back; ɔrinted detailed record below gives the average daily ımption for each feeding period. Three cows, Eva, ıie and May, received periodically the same diet as the mentioned two. This daily diet was however replaced ıted times by the following one:

Corn Meal, ...	3¼ pounds.
Wheat Bran, ...	3¼ pounds.
English Hay, ...	5 pounds.

ıs much of either green vetch and oats or green south- cow-pea or green serradella as the animals on trial d consume.

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The average of the daily consumption in e period is stated in the subsequent record of the One-fourth (five pounds) of the adopted fu ration has been retained in our green fodder purpose of preventing disorders in the digestion quantity of green fodder.

The green fodder diet has produced in two ca and serradella, a decided temporary increase in of milk when compared with the English hay substitution of three-fourths of the full hay rat pea and serradella has given also satisfactory re as the quality of the milk, the net cost of feed a eral condition of the animals on trial are conc serradella leads as a rule.

The substitution of hay by the mixed crop o oats has not shown in some directions as deci tages. This circumstance may find its explan future by the fact that our mixed crop, vetch an sisted of one-tenth in dry weight of vetch to ni that of oats; it ought to contain from one to t weights. The vetches rank among the better cl crops furnished by the great and important fam minous plants. Green vetch when fed with g more relished by cattle than when fed alone.

The cost of green fodder is based on that of per ton, allowing two tons of hay, with 15 p moisture, as the average produce of English ha This mode of valuation has been adopted on acc entire absence of market prices as far as green pea and serradella are concerned. These crops rank higher in the scale of an agricultural va the meadow grass.

Produce Per Acre of Green Crops raised on the Station

6.80 tons of grass at 75 per cent. moisture, equals 2 tons moisture.

10.89 tons of vetch and oats at 73.36 per cent. moisture, e at 15 per cent. moisture.

9.56 tons of cow pea at 80.62 per cent. moisture, equals per cent. moisture.

9.50 tons of serradella at 80.14 per cent. moisture, equals per cent. moisture.

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Valuation Per Ton of the Articles of Fodder used.

Bran, ...	$21.00	Green Cow Pea, . .	$3.14
eal, ...	21.00	Green Serradella, . .	3.16
. . . . .	15.00	Green Grass, ...	4.41
etch and Oats, .	2.75		

w subsequent pages contain a more detailed statement actual observations.

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FEEDING RECORD.

LIZZIE: Five Years; Native; Last Calf, Feb. 1, 1887.

Feeding Periods.	Feed Consumed (pounds) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Wheat Bran.	Corn Meal.	Hay.					
1887.								
1. June 2 to Aug. 23, ...	3.25	3.25	19.89	23.46	12.73	1.84	1:8.54	986.45
2. Sept. 1 to Oct. 25, ...	3.25	3.25	24.44	27.52	9.59	2.86	1:8.72	1,011.56

IDA: Seven Years; Grade, Durham; Last Calf, Feb. 3, 1887.

1887.								
1. June 2 to Aug. 23, ...	3.25	3.25	19.89	23.46	12.73	1.84	1:8.54	986.45
2. Sept. 1 to Oct. 25, ...	3.25	3.25	24.44	27.52	9.59	2.86	1:8.72	1,011.56

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(LIZZIE.)

	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Hay consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of Milk for period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to Aug. 23, ...	1,056.50	12.73	269.75	269.75	1,651.25	$18 04	1.70
2. Sept. 1 to Oct. 25, ...	527 75	9.59	178.75	178.75	1,344.00	13 84	2.62

(IDA.)

1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to Aug. 23, ...	625.75	7.54	269.75	269.75	1,650.30	$18 04	2.88
2. Sept. 1 to Oct. 25, ...	269.25	4.89	178.75	178.75	1,307 75	13 57	5.04

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Manurial Value of Feed.

(LIZZIE.)

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net cost of Feed for the production of Milk during period.	Net cost of Feed for the production of one quart of Milk.	Weight of animal at close of period.
1887.					Cents.	Lbs.
1. June 2 to Aug. 23, ...	$18 04	$8 40	$6 72	$11 32	1.07	980.00
2. Sept. 1 to Oct. 25, ...	13 84	6 42	5 14	8 70	1.64	1,015.00
Total, ...	$31 88	$14 82	$11 86	$20 02	–	–

(IDA.)

1887.					Cents.	Lbs.
1. June 2 to Aug. 23, ...	$18 04	$8 40	$6 72	$11 32	1.80	980.00

EVA: AGE SEVEN YEARS; GRADE, JERSEY, LAST CALF, JAN. 20, 1887.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 2 to July 7, ...	3.25	3.25	19.88	–	–	–	23.45	11.64	2.01	1 : 8.54	937.70
2. July 12 to 26, ...	3.25	3.25	5.00	59.15	–	–	25.93	10.20	2.54	1 : 6.94	902.50
3. Aug. 1 to 7, ...	3.25	3.25	19.82	–	–	–	23.39	9.10	2.57	1 : 8.51	917.50
4. Aug. 14 to Sept. 1, ...	3.25	3.25	5.00	–	97.37	–	28.94	10.71	2.70	1 : 9.01	875.83
5. Sept. 6 to 27, ...	3.25	3.25	5.22	–	–	97.12	29.52	9.57	3.08	1 : 5.38	933.12
6. Oct. 3 to 25, ...	3.25	3.25	23.52	–	–	–	26.69	7.73	3.45	1 : 8.67	938.12

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FEEDING RECORD — Continued.

MINNIE: AGE, SEVEN YEARS; GRADE, AYRSHIRE; LAST CALF, MAY 3, 1887.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 2 to July 7, ...	3.25	3.25	19.97	–	–	–	23.53	15.73	1.49	1:8.51	905.00
2. July 12 to 26, ...	3.25	3.25	5.00	67.80	–	–	28.24	14.53	1.94	1:6.94	895.83
3. Aug. 1 to 7, ...	3.25	3.25	20.14	–	–	–	23.64	12.60	1.87	1:8.57	990.00
4. Aug. 14 to Sept. 1, ...	3.25	3.25	5.00	–	97.37	–	28.94	15.09	1.92	1:9.01	896.66
5. Sept. 6 to 27, ...	3.25	3.25	5.22	–	–	98.20	29.74	14.81	2.01	1:5.36	947.50
6. Oct. 3 to 25, ...	3.25	3.25	24.42	–	–	–	27.50	11.60	2.57	1:8.72	958.12

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FEEDING RECORD — Concluded.

MAY: AGE, SIX YEARS; GRADE, JERSEY; LAST CALF, JUNE 6, 1887.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 19 to July 7, ...	3.25	3.25	19.82	–	–	–	23.39	13.90	1.68	1 : 8.51	815.50
2. July 12 to 26, ...	3.25	3.25	5.00	64.23	–	–	27.28	12.90	2.11	1 : 6.94	801.25
3. Aug. 1 to 7, ...	3.25	3.25	20.04	–	–	–	23.58	11.78	2.00	1 : 8.53	795.00
4. Aug. 14 to Sept. 1, ...	3.25	3.25	5.00	–	97.37	–	28.94	12.10	2.39	1 : 9.01	777.50
5. Sept. 6, to 27, ...	3.25	3.25	5.22	–	–	97.71	29.64	11.85	2.50	1 : 5.45	822.50
6. Oct. 3, to 25, ...	3.25	3.25	24.18	–	–	–	27.28	9.93	2.75	1 : 8.70	849.37

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Total Cost of Feed per Quart of Milk.

(EVA.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during period.	Total amount of Cow Pea consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for Period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to July 7, ...	419.00	11.64	117.00	117.00	716.00	–	–	–	$7 83	1.39
2. July 12 to 26, ...	153.00	10.20	48.75	48.75	75.00	887.25	–	–	2 81	1.84
3. Aug. 1 to 7, ...	63.75	9.10	22.75	22.75	138.75	–	–	–	1 52	2.38
4. Aug. 14 to Sept. 1, ...	203.50	10.71	61.75	61.75	95.00	–	1,850.00	–	4 91	2.41
5. Sept. 6 to 27, ...	210.50	9.57	71.50	71.50	115.00	–	–	2,136.75	5 74	2.25
6. Oct. 3 to 25	178.25	7.73	74.75	74.75	521.00				5 46	2.06

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Total Cost of Feed per Quart of Milk — Continued.

(MINNIE.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during Period.	Total amount of Cow Pea Consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to July 7, ...	566.25	15.73	117.00	117.00	719.00	–	–	–	$7 85	1.38
2. July 12 to 26, ...	218.00	14.53	48.75	48.75	75.00	1,017.00	–	–	2 99	1.37
3. Aug. 1 to 7, ...	88.25	12.60	22.75	22.75	141.00	–	–	–	1 54	1.74
4. Aug. 14 to Sept. 1, ...	286.70	15.09	61.75	61.75	95.00	–	1,850.00	–	4 91	1.72
5. Sept. 6 to 27, ...	326.00	14.81	71.50	71.50	115.00	–	–	2,160.50	5 78	1.77
6. Oct. 3 to 25, ...	267.00	11.60	74.75	74.75	561.75	–	–	–	5 77	2.16

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Total Cost of Feed per Quart of Milk — Concluded.

(MAY.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during Period.	Total amount of Cow Pea Consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for Period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 19 to July 7, ...	264.25	13.90	61.75	61.75	376.50	–	–	–	$4 12	1.55
2. July 12 to 26, ...	193.50	12.90	48.75	48.75	75.00	963.50	–	–	2 92	1.51
3. Aug. 1 to 7, ...	78.25	11.78	22.75	22.75	140.25	–	–	–	1 54	1.96
4. Aug. 14 to Sept 1, ...	230.00	12.10	61.75	61.75	95.00	–	1,850.00	–	4 91	2.13
5. Sept. 6 to 27, ...	260.75	11.85	71.50	71.50	115.00	–	–	2,149.50	5 76	2.21

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uation of Essential Fertilizing Constituents contained in the various Articles of Fodder Used.

ogen, 17 cents per pound; Phosphoric acid, 6 cents; Potassium oxide, 4½ cents.

(*Per cent.*)

	Wheat Bran.	Corn Meal.	Hay.	Green Vetch and Oats.	Green Cow Pea.	Green Serradella.
ogen, ...	2.80	1.66	1.41	0.451	0.274	0.379
phoric acid, . . .	2.36	0.77	0.41	0.100	0.098	0.124
sium oxide, . . .	1.36	0.45	1.84	0.838	0.306	0.398
ation per 2,000 pounds,	$13 51	$6 94	$6 84	$2 36	$1 31	$1 77

Manurial Value of Feed.

(EVA.)

DING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net Cost of Feed for the production of Milk during Period.	Net Cost of Feed for the production of one Quart of Milk.	Weight of animal at close of Period.
1887.					Cents.	Lbs.
ne 2 to July 7,	$7 83	$3 64	$2 91	$4 92	1.17	956.00
y 12 to 26, .	2 81	1 80	1 44	1 37	0.89	922.50
g. 1 to 7, .	1 52	71	57	95	1.49	917.50
g. 14 to Sept. 1,	4 91	2 16	1 73	3 18	1.56	887.50
pt. 6 to 27, .	5 74	3 03	2 42	3 32	1.57	995.00
. 3 to 25, .	5 46	2 55	2 04	3 42	1.91	957.50
otal, . .	$28 27	$13 89	$11 11	$17 16	–	–

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Manurial Value of Feed — Continued.

(MINNIE.)

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net Cost of Feed for the production of Milk during Period.
1887.				
1. June 2 to July 7,	$7 85	$3 65	$2 92	$4 93
2. July 12 to 26, .	2 99	1 96	1 57	1 42
3. Aug. 1 to 7, .	1 54	71	57	97
4. Aug. 14 to Sept. 1,	4 91	2 16	1 73	3 18
5. Sept. 6 to 27, .	5 78	3 05	2 44	3 34
6. Oct. 3 to 25, .	5 77	2 68	2 15	3 62
Total, . . .	$28 84	$14 21	$11 38	$17 46

(MAY.)

1887.				
1. June 19 to July 7,	$4 12	$1 92	$1 54	$2 58
2. July 12 to 26, .	2 92	1 89	1 51	1 41
3. Aug. 1 to 7, .	1 54	71	57	97
4. Aug. 14 to Sept. 1,	4 91	2 16	1 73	3 18
5. Sept. 6 to 27, .	5 76	3 05	2 44	3 32
6. Oct. 3 to 25, .	5 73	2 66	2 13	3 60
Total, . .	$23 98	$12 39	$9 92	$14 06

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Analyses of Milk.

LIZZIE.

(Per cent.)

	June 22.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 26.
r, ...	–	87.38	–	–	86.84	–	85.91
, ...	–	12.62	–	–	13.16	–	14.09
n solids), . .	–	4.12	–	–	4.20	–	5.25
IDA.							
r, ...	–	86.87	–	–	86.82	–	87.18
, ...	–	13.13	–	–	13.18	–	12.82
n solids), . .	–	4.75	–	–	4.25	–	4.70
EVA.							
r, ...	–	85.05	85.59	85.50	85.77	84.73	83.99
, ...	–	14.95	14.41	14.50	14.23	15.27	16.01
n solids), . .	–	5.53	5.39	5.08	4.76	5.46	5.93
MINNIE.							
, ...	–	87.25	89.06	87.97	87.23	87.40	87.15
, ...	–	12.75	10.94	12.03	12.77	12.60	12.85
n solids), . .	–	4.09	2.75	3.35	4.09	3.74	4.04
MAY.							
, ...	86.46	87.00	87.30	88.23	87.13	87.35	86.52
, ...	13.54	13.00	12.70	11.77	12.87	12.65	13.48
n solids), . .	3.82	3.76	3.46	3.13	3.76	3.71	4.34

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Analyses of Fodder Articles used in Ex

VETCH AND OATS.

	Percentage Composition.	Constituents (In lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	73.36	1,467.20	–
Dry Matter,	26.64	532.80	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	12.37	247.40	–
" Cellulose,	34.20	684.00	–
" Fat,	2.74	54.80	27.40
" Protein (Nitrogenous Matter),	10.59	211.80	127.08
Non-nitrogenous Extract Matter,	40.10	802.00	802.00
	100.00	2,000.00	956.48

COW PEA.

	Percentage Composition.	Constituents (In lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	80.62	1,612.40	–
Dry Matter,	19.38	387.60	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	5.97	119.40	–
" Cellulose,	23.02	60.40	216.39
" Fat,	1.81	36.20	21.36
" Protein (Nitrogenous Matter),	8.58	171.60	102.96
Non-nitrogenous Extract Matter,	60.62	1,212.40	936.56
	100.00	2,000.00	1,277.27

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SERRADELLA.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
e, at 100° C., . .	80.14	1,602.80	–	–	
tter, ...	19.86	397.20	–	–	
	100.00	2,000.00	–	–	
sis of Dry Matter.					
sh, ...	11.53	230.60	–	–	1:5.03
Cellulose, . . .	38.76	775.20	–	–	
Fat, ...	2.09	41.80	25.08	60	
Protein (Nitrogenous Matter), . .	12.17	243.40	153.34	63	
rogenous Extract r, ...	35.45	709.00	709.00	100	
	100.00	2,000.00	887.42	–	

es of Green Crops with reference to Fertilizing Constituents.

	Per Cent.		
	Vetch and Oats.	Cow Pea.	Serradella.
e at 100° C., ...	73.36	80.62	80.140
oric acid, ...	.100	.098	.124
m oxide, ...	.838	.306	.398
oxide, ...	.033	.063	.098
oxide, ...	.092	.300	.472
ium oxide, ...	.031	.099	.067
xide, ...	.012	.016	.021
n, ...	.451	.274	.379
e matter, ...	.352	.077	.157

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WHEAT BRAN.

73.36 per cent. passed through Mesh 144 to squa

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	11.14	222.80	–
Dry Matter,	88.86	1,777.20	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	6.59	131.80	–
" Cellulose,	12.80	256.00	51.20
" Fat,	6.00	120.00	96.00
" Protein (Nitrogenous Matter),	17.72	354.40	311.87
Non-nitrogenous Extract Matter,	56.89	1,137.80	910.24
	100.00	2,000.00	1,369.31

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	13.08	261.60	–
Dry Matter,	86.92	1,738.40	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	1.66	33.20	–
" Cellulose,	3.49	69.80	23.73
" Fat,	4.97	99.40	75.54
" Protein (Nitrogenous Matter),	10.39	207.80	176.63
Non-nitrogenous Extract Matter,	79.49	1,589.80	1,494.41
	100.00	2,000.00	1,770.41

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HAY.

[From Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
at 100° C., . . .	10.78	215.60	–	–	1:10.54
er, ...	89.22	1,784.40	–	–	
	100.00	2,000.00	–	–	
is of Dry Matter.					
h, ...	7.11	142.20	–	–	
llulose, ...	35.55	711.00	412.38	58	
t, ...	2.63	52.60	24.19	46	
otein (Nitrogenous Matter), . . .	8.75	175.00	99.75	57	
ogenous Extract	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.42	–	

l Creamery Record from November 1, 1886, to October 31, 1887.

	Quarts of Milk Produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount Received from Creamery.
1886.				
er 1 to 30, . .	1,178¼	380	4 cents.	$15 20
r 1 to 31, . .	1,153¼	414	4 "	16 56
1887.				
1 to 31, . .	1,002	416	3⅞ "	16 12
1 to 28, . .	2,191	1,007	3¾ "	37 76
to 31, . . .	2,525¼	1,044	3¾ "	39 15
30, ...	2,296½	834	3⅝ "	30 23
31, ...	1,735¾	928	3⅜ "	31 32
30, ...	1,931	968	3 "	29 04
31, ...	1,852¾	855	3⅛ "	26 72
to 31, . . .	1,869	990	3½ "	34 65
er 1 to 30, . .	1,920¼	1,002	3½ "	35 07
l to 31, . .	1,662½	930	3¾ "	34 87
	21,317½	9,768	–	$346 69

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November, 1886.		6.60 spaces of cream make 1 lb. butte cents per pound.
December, 1887.		6.60 spaces of cream make 1 lb. butte cents per pound.
January,	"	6.60 spaces of cream make 1 lb. butte cents per pound.
February,	"	6.55 spaces of cream make 1 lb. butte cents per pound.
March,	"	6.33 spaces of cream make 1 lb. butte cents per pound.
April,	"	6.37 spaces of cream make 1 lb. butte cents per pound.
May,	"	6.30 spaces of cream make 1 lb. butte cents per pound.
June,	"	6.47 spaces of cream make 1 lb. butte cents per pound.
July,	"	6.31 spaces of cream make 1 lb. butte cents per pound.
August,	"	6.44 spaces of cream make 1 lb. butte cents per pound.
September,	"	6.55 spaces of cream make 1 lb. butte cents per pound.
October,	"	6.55 spaces of cream make 1 lb. butte cents per pound.

During the first three months — Novembe and January — the milk was furnished by thre during the remainder of the time by six cows.

The total amount of milk set was 21,317½ total receipts for cream produced were $346.6 average, 1.63 cents per quart of milk produced

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3. Feeding Experiments with Pigs.

observations recorded below are a continuation of g experiments with pigs, described in our Second and Annual Reports. The first of these experiments (see, tails, Second Annual Report, page 68) was instituted e purpose of comparing the feeding effects of *equal res* of creamery buttermilk — Amherst creamery — skim-milk from the Station, adding in both instances daily diet a corresponding amount of corn meal. aily ration of corn meal was from time to time in- d, independent of the amount of milk fed at the time, the progress of the growth of the animals on trial. esults of this experiment showed practically no differ- n regard to the amount of dressed pork produced in case.

eated examinations of the two kinds of milk used in ial had proved that the skim-milk contained on an e one-fifth, or twenty per cent., more solid matter milar character than the creamery buttermilk at our al.

excess of solids in the skim-milk, judging from our , seemed to be wasted in our mode of feeding; for unds of corn meal and 982 gallons of skim-mik (with cent. of solids) had produced 510 pounds of dressed whilst 718 pounds of corn meal and 985 gallons of ery buttermilk (with 8 per cent. of solids) had yielded, otherwise corresponding circumstances, 515 pounds ssed pork, as the total amount from three pigs on each

account, if possible, for the less satisfactory returns of im-milk diet, as compared with that of the creamery milk, the second feeding experiment was planned or details, Third Annual Report, page 23). It was de- to calculate the amount of corn meal to be fed in the xperiment with reference *to an equal amount* of *solids kinds of milk* and *not* with reference to *any equal re* of both kinds.

average result of this trial seemed to account quite ctorily for the above-stated difference in solids of both

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kinds of milk; for 2,250 pounds of corn meal fe
gallons of skim-milk had produced 990½ pounds
pork, whilst 2,211 pounds of corn meal fed wit
lons of creamery buttermilk had yielded, unde
corresponding circumstances, 889½ pounds of d
as the total returns from six pigs on each si
stated on that occasion, that, in our opinion, *a*
cious distribution of an *increased proportion* of *c*
case of the skim-milk diet had evidently rendere
pound for pound, more efficient during the se
ment, as compared with the first.

Having adopted the same local market prices
articles, which served in the daily diet during
ments,— corn meal per ton, $22.50; skim-milk
per gallon; buttermilk, 1.37 cents per gallon, —
that the cost of feed consumed, per pound of d
produced, in the first experiment, amounted in
creamery buttermilk diet to 4.6 cents, in case o
milk diet to 5.8 cents; whilst in the second ex
amounted, in case of the former to 4.2 cents,
of the latter to 4.85 cents. In calculating the
food consumed in each case on the *above-stated m*
the creamery buttermilk had proved the cheaper
higher nutritive value of the more concentrated
from our dairy had been more than offset by the
ket price of the *creamery buttermilk*. The ado
equal market price per gallon of *skim-milk and*
buttermilk, 1.37 cents per gallon, would have cau
tion in the above-stated cost of feed, per pound
pork, of from .65 to .75 cents in favor of the s

Before proceeding with the description of t
ceeding experiments, it seems advisable to
explanatory remarks regarding the standpoint
the planning and management of the work
discussion. In the published detailed record of
feeding experiment (see Third Annual Repo
be noticed that the character of the daily
changed from time to time by adding a larg
tion of corn meal to a given amount of sk
buttermilk. The quantity of feed offered daily

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on trial was controlled by their individual appetite, — nning with eight and twelve ounces of meal to four ts of milk and closing with a daily ration consisting, se of one lot of animals, of ninety-one ounces of corn and twelve quarts of buttermilk per head, and in case e other, of one hundred and eight ounces of corn meal ven quarts of skim-milk. The changes regarding the tity of the daily supply of feed were, for obvious rea-, gradual and depending on the appetite of each animal. alterations regarding the character of the daily feed — the changes in the relative proportion of meal and — were made with reference to the stage of growth of animals on trial. The proportions between meal and were changed from four to five times. These changes sted in a periodical increase of meal for a given amount ilk; they were made for the purpose of increasing the nt of non-nitrogenous fodder constituents in the daily during the later stages of growth. This course of pre-g the daily feed was adopted to secure, whenever de-, a definite change in the relative proportion of its tible nitrogenous and non-nitrogenous food constituents. oth kinds of milk used in the experiment contained the genous food constituents in a much larger proportion .8,—1 :1.9) than the corn meal (1 :8.76), an increase in quantity of the latter rendered it possible to regulate, n certain limits, the character (nutritive ratio) of the diet, with reference to a desired proportion of both ps of essential food constituents. The experiment (II.) n with a daily diet, consisting of skim-milk and corn , which contained one part of digestible nitrogenous food ituents to 2 :7 parts of digestible non-nitrogenous food ituents; this proportion was subsequently altered by an ase in corn meal to 1 :3.1, later on to 1 :3.9, and closed 1 :5. The animals which served in this particular case d in weight from 17 to 19 pounds at the beginning of the riment. The first stated ration was fed until the animals reached a weight of from 45 to 50 pounds; the second they had reached from 90 to 100 pounds, the third until o 145 pounds, and the fourth subsequently to the end of rial. The final summing up of the results of that experi-

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ment showed, when including the entire numb
trial (twelve), that 3.39 pounds of dry matter
the feed consumed had yielded one pound of d
In two instances (of the buttermilk diet) from
pounds of dry matter of the feed had been c
one pound of dressed pork obtained; while
instances (of the skim-milk diet) from 2.97 to
of dry matter of the feed had sufficed for the p
the same weight of dressed pork (one pound).

As it seemed of interest to learn whether t
course pursued in the previously described ex
feeding skim-milk from the home dairy with co
be improved on, and, if so, in what direction, t
sequently described new feeding experiments
tuted. *The principal aim of these new exp*
to ascertain whether a daily diet for pigs, of
milk and corn meal formed a material po
secure better pecuniary returns, in case an excep
proportion of digestible nitrogenous food constit
during the entire experiment. Gluten meal an
were chosen for various reasons to serve in ma
feed to meet this requirement as soon as our
became exhausted. A short abstract of the res
in this connection may be found upon a fe
pages. Although not less than four animals ha
each of these five new experiments, our present
tion will be confined to a *detailed* record of but
in each case, with the exception of the last experi

Third Feeding Experiment (A, B

Four animals of a mixed breed were selected
their respective weights varied from 40 to 59 p
daily diet during the first three months consiste
of skim-milk from the Station and of corn mea
remainder of the time (three and a half month
of equal weights of wheat bran and gluten mea
to assist in maintaining the desired close relat
the proportion of digestible nitrogenous and
ous food constituents in the daily food.
between these two important groups of food

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naterially the same during the entire experiment. It sted of one part of nitrogenous food constituents to 3.27 to 3.76 parts of non-nitrogenous constituents. four and one-half to five ounces of corn meal were l to every quart of skim-milk needed, to meet the s of the animal. This composition of the feed was re- d until the quantity called for per head had reached quarts of skim-milk and forty ounces of corn meal per At this stage of the experiment the mixture of equal nts of wheat bran and gluten meal was added to the fodder ration; beginning with sixteen ounces per head, losing up with twenty-five ounces. The exact amount red per day was governed by the appetite of the ani- the mixture served to meet the increasing demand of arious animals on trial. It is a good rule to increase laily fodder rations only when called for, and always ually.

e subsequent detailed record of our results shows that ost of feed consumed per pound of dressed weight pro- l varied from 6.2 cents to 6.6 cents, while from 4.10 .18 pounds of dry matter contained in the feed con- d had yielded one pound of dressed pork. The live nts gained during the experiment amounted to 246.5 206.5 pounds.

[A.]

RIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
885.								lb. oz.
to May 11,	73.5	257.0	-	-	1:3.29	40.0	84.8	1 1
to June 3,	57.5	184.0	-	-	1:3.39	84.8	110.5	1 2
to June 29,	49.0	208.0	8.9	8.0	1:3.04	110.5	150.5	1 9
to Aug. 12,	121.0	352.0	25.0	25.0	1:3.35	150.5	212.0	1 6
to Sept. 16,	105.0	210.0	22.0	22.0	1:3.67	212.0	246.5	1 0

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Total Amount of Feed Consumed from April 1 to S

406 lbs. Corn Meal, equal to dry matter, . . .
1,211 qts. Skim-Milk, equal to dry matter, . . .
55 lbs. Wheat Bran, equal to dry matter, . . .
55 lbs. Gluten Meal, equal to dry matter, . . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment, .
Live weight at time of killing, ...
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, ... 36.5 lbs., or
Dressed weight gained during experiment, . . .

Cost of Feed Consumed during Experiment.

406 lbs. of Corn Meal, at $24.00 per ton, . . .
303 gals. Skim-Milk, at 1.8 cents per gallon, . .
55 lbs. Wheat Bran, at $22.50 per ton, ...
55 lbs. Gluten Meal, at $22.50 per ton, ...

3.54 lbs. of dry matter fed yielded 1 lb. of live weight; a
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 6.6 c

[B.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.
1885.						
April 1 to May 11,	73.5	257.0	–	–	1:3.29	59.5
May 12 to June 3,	57.5	184.0	–	–	1:3.39	109.3
June 4 to June 29,	65.0	208.0	13.0	13.0	1:3.27	133.3
June 30 to July 22,	69.0	184.0	17.0	17.0	1:3.39	188.5
July 23 to Sept. 16,	210.0	378.0	44.0	44.0	1:3.76	223.0

Total Amount of Feed Consumed from April 1 to S

475 lbs. Corn Meal, equal to dry matter, . . .
1,211 qts. Skim-Milk, equal to dry matter, . . .
74 lbs. Wheat Bran, equal to dry matter, . . .
74 lbs. Gluten Meal, equal to dry matter, . . .

Total amount of dry matter, ...

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weight of animal at beginning of experiment,	59.5 lbs.
weight at time of killing,	306.0 "
weight gained during experiment,	246.5 "
ed weight at time of killing,	258.0 "
in weight by dressing,	48 lbs., or 12.4 per cent.
ed weight gained during experiment,	205.9 lbs.

Cost of Feed Consumed during Experiment.

s. Corn Meal, at $24.00 per ton,	$5 70
als. Skim-Milk, at 1.8 cents per gallon,	5 45
. Wheat Bran at $22.50 per ton,	0 83
. Gluten Meal, at $22.50 per ton,	0 83
	$12 81

bs. of dry matter fed yielded 1 lb. of live weight, and 4.01 lbs. of ry matter yielded 1 lb. of dressed weight.
of feed for production of 1 lb. of dressed pork, 6.2 cents.

Fourth Feeding Experiment (C, D).

ve animals served in the experiment; their live weights ed from 30 to 38 pounds when entering upon the trial; were of a similar mixed breed as those selected for the experiment. The daily diet of the entire lot consisted, December 8 to February 15, of four quarts of skim- and eight ounces of corn meal, besides a mixture con- ng of two weight parts of gluten meal and one weight of wheat bran; the increase demand for feed was sup- l by this mixture, which was moistened with water re being fed. The daily quantity needed per head unted in the beginning of the trial to three ounces and towards the close of that period to 12 ounces. Subse- tly — until the 11th of May — another mixture, consist- of equal weights of corn meal, gluten meal and wheat , was substituted in its place. After May 11 until close of the experiment, May 31, a larger proportion rn meal was fed. The daily diet consisted, during that od, of four quarts of skim-milk and a mixture of dry consisting of seven parts of corn meal, one part of en meal and one part of wheat bran. On the 12th of the daily diet consisted, on an average per head, of quarts of skim-milk, twenty-eight ounces of corn meal, ounces of gluten meal and four ounces of wheat bran. consumption of the solid constituents of the daily fod-

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der ration had reached, at the close of the ex
some instances, fifty-six ounces of corn meal,
of gluten meal and eight ounces of wheat bran
quantity of milk fed remained the same durin
experiment, — four quarts per head. Water
assist in moistening the dry portion of the feed

A comparison of the subsequent statement o
with those in the preceding experiment (III
marked differences; the results are, if anything
considering the weight of the animals in both
killed. The cost of the feed consumed, pe
dressed weight produced, varied from 6.1 to
while from 3.77 to 4.08 pounds of dry matter
the feed consumed had yielded one pound of d

The live weights gained during the experime
to 128 and 111 pounds. The cost of feed cons
production of a given quantity of dressed po
materially with the *advancing growth* of the
details concerning this important point see stat
Third Annual Report. The financial success of
for home market *depends*, in a *controlling degre*
closing up of the operation. To go beyond 160 –
of live weight is only, in exceptional cases, a
practice with our average market prices for dre

The beneficial effects of a more liberal suppl
trogenous feed constituents, as starch and fats (i
during the last period of this feeding experime
particular attention.

[C.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of
1885 and 1886.						
Dec. 8 to Jan. 25,	24.5	196.0	5.6	11.2	1:2.68	31.
Jan. 26 to Feb. 15,	10.5	84.0	4.8	9.6	1:2.81	66.
Feb. 16 to Mar. 23,	26.8	144.0	8.8	8.8	1:3.01	82.
Mar. 24 to May 10,	28.6	233.0	5.6	5.6	1:2.66	92.
May 11 to May 31,	55.4	84.0	8.2	8.2	1:4.33	119.

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Total Amount of Feed Consumed from Dec. 8 to May 31.

lbs. Corn Meal, equal to dry matter,	127.4 lbs.
qts. Skim-Milk, equal to dry matter,	167.8 "
s. Wheat Bran, equal to dry matter,	28.6 "
s. Gluten Meal, equal to dry matter,	40.5 "
otal amount of dry matter,	364.3 lbs.
veight of animal at beginning of experiment,	31.8 lbs.
veight at time of killing,	142.8 "
veight gained during experiment,	111.0 "
ed weight at time of killing,	115.0 "
n weight by dressing,	27.8 lbs., or 19.3 per cent.
ed weight gained during experiment,	89.3 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton,	$1 75
gals. Skim-Milk, at 1.8 cents per gallon,	3 30
s. Wheat Bran at $22.50 per ton,	0 37
s. Gluten Meal at $22.50 per ton,	0 49
	$5 91

bs. of dry matter fed yielded 1 lb. of live weight, and 4.08 lbs. of
y matter yielded 1 lb. of dressed weight.
f feed for production of 1 lb. of dressed pork, 6.6 cents.

[D.]

RIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
and 1886.								lb. oz.
to Jan. 25,	24.5	196.0	4.4	8.8	1:2.64	34.0	70.0	0 12
to Feb. 15,	10.5	84.0	5.2	10.4	1:2.78	70.0	90.5	1 0
to April 3,	38.7	188.0	15.2	15.2	1:3.06	90.5	118.0	0 9
to May 10,	25.8	188.0	7.3	7.3	1:2.86	118.0	137.5	0 8
to May 31,	60.0	81.0	8.4	8.4	1:4.48	137.5	162.0	1 2

Total Amount of Feed Consumed from Dec. 8 to May 31.

lbs. Corn Meal, equal to dry matter,	138.4 lbs.
qts. Skim-Milk, equal to dry matter,	167.2 "
s. Wheat Bran, equal to dry matter,	35.7 "
s. Gluten Meal, equal to dry matter,	46.0 "
otal amount of dry matter,	387.3 lbs.

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Live weight of animal at beginning of experiment, .
Live weight at time of killing, ...
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, . . . 32 lbs., or
Dressed weight gained during experiment, . . .

Cost of Feed Consumed during Experiment.

159.5 lbs. Corn Meal, at $24.00 per ton, . . .
184.0 gals. Skim Milk, at 1.8 cents per gallon, . .
40.5 lbs. Wheat Bran, at $22.50 per ton, . . .
50.1 lbs. Gluten Meal, at $22.50 per ton, . . .

3.02 lbs. of dry matter fed yielded 1 lb. of live weight, ar
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 6.1 c

Fifth Feeding Experiment (E, F, G,

Six pigs of a mixed breed were secured for t
tion; their live weights varied at the beginning
periment from 25 to 30 pounds. The course of
similar to that adopted in the two previous e
Skim-milk and corn meal furnished, as in the pre
a liberal proportion of the daily diet; gluten mea
bran were used in a somewhat different prop
before as food ingredients to compound the d
porary fodder ration. The feeding began with
of skim-milk and eight ounces of corn meal; t
ing daily demand for feed was supplied by a
equal weights of gluten meal and wheat bran un
31, when a mixture of equal weights of gluten
meal and wheat bran took its place in providing
daily fodder ration, until the close of the exper
uary 15, 1887. At that time from forty-two to
ounces of this mixture were required per head.

The results of this experiment, judging from
more detailed statements, are in some instances r
able than those previously described; yet they
those obtained in our earlier experiments (I
The cost of feed consumed per pound of dressed p
in three cases, from 5.2 to 5.8 cents, and reac
case 6.32 cents. The amount of dry matter i

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umed for the production of one pound of dressed pork d, in three cases, from 3.56 to 3.99 pounds, and rose, e case, to 4.31 pounds. The live weight gained during ntire experiment varied from 132 to 158 pounds. Two als were sick for some weeks and appear not in the d below.

[E.]

RIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
and 1887.								lb. oz.
5 to Oct. 4,	10.0	80.0	6.8	6.8	1:2.75	30.8	51.5	1 1
5 to Oct. 31,	13.5	108.0	35.8	35.8	1:2.90	51.5	89.0	1 6
1 to Dec. 10,	66.0	160.0	46.0	46.0	1:3.52	89.0	133.0	1 2
1 to Jan. 15,	47.8	144.0	29.8	29.8	1:3.39	133.0	164.3	0 14

Total Amount of Feed Consumed from Sept. 15 to Jan. 15.

lbs. Corn Meal, equal to dry matter,	119.58 lbs.
qts. Skim-milk, equal to dry matter,	111.58 "
lbs. Wheat Bran, equal to dry matter,	102.99 "
lbs. Gluten Meal, equal to dry matter,	106.89 "
Total amount of dry matter,	441.04 lbs.

weight of animal at beginning of experiment,	30.8 lbs.
weight at the time of killing,	164.3 "
weight gained during experiment,	133.5 "
ed weight at time of killing,	136.0 "
in weight by dressing,	28.5 lbs., or 17.3 per cent.
ed weight gained during experiment,	110.5 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton,	$1 64
gals. of Skim-milk, at 1.8 cents per gallon,	2 21
lbs. Wheat Bran, at $22.50 per ton,	1 32
lbs. Gluten Meal, at $22.50 per ton,	1 32
	$6.49

bs. of dry matter fed yielded 1 lb. of live weight, and 3.99 lbs. of ry matter yielded 1 lb. of dressed weight.

of feed for production of 1 lb. of dressed pork, 5.8 cents.

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[F.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.)	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of
1886 and 1887.						
Sept. 15 to Oct. 4,	10.0	80.0	6.3	6.3	1:2.75	3
Oct. 5 to Oct. 31,	13.5	108.0	35.0	35.0	1:2.90	5
Nov. 1 to Dec. 10,	69.3	160.0	49.3	49.3	1:3.57	9
Dec. 11 to Jan. 19,	58.0	160.0	38.0	38.0	1:3.45	15

Total Amount of Feed Consumed from Sept. 15 t

150.8 lbs. Corn Meal, equal to dry matter, . . .
508.0 qts. Skim-milk, equal to dry matter, . . .
128.6 lbs. Wheat Bran, equal to dry matter, . .
128.6 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment, .
Live weight at time of killing, ...
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, . . . 30.3 lbs.,
Dressed weight gained during experiment, . .

Cost of Feed Consumed during Experimen

150.8 lbs. Corn Meal, at $24.00 per ton, . . .
127.0 gals. Skim-milk at 1.8 cents per gallon, . .
128.6 lbs. Wheat Bran, at $22.50 per ton, . . .
128.6 lbs. Gluten Meal, at $22.50 per ton, . . .

3.04 lbs. of dry matter fed yielded 1 lb. of live weight,
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.2

[G.]

Total Amount of Feed Consumed from Sept. 15 t

150.0 lbs. Corn Meal, equal to dry matter, . . .
508.0 qts. Skim-milk, equal to dry matter, . . .
128.0 lbs. Wheat Bran, equal to dry matter, . .
128.0 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

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weight of animal at beginning of experiment,	32.0 lbs.
weight at time of killing,	164.0 "
weight gained during experiment,	132.0 "
sed weight at time of killing,	137.0 "
in weight by dressing,	27.0 lbs., or 16.4 per cent.
sed weight gained during experiment,	110.2 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton,	$1 80
gals. Skim-milk, at 1.8 cents per gallon,	2 29
lbs. Wheat Bran, at $22.50 per ton	1 44
lbs. Gluten Meal, at $22.50 per ton,	1 44
	$6 97

bs. of dry matter fed yielded 1 lb. of live weight, and 4.31 lbs. of ry matter yielded 1 lb. of dressed weight.
of feed for production of 1 lb. of dressed pork, 6.3 cents.

[H.]

Total Amount of Feed Consumed, from Sept. 15 to Jan. 19.

lbs. Corn Meal, equal to dry matter,	130.63 lbs.
qts. Skim-milk, equal to dry matter,	115.21 "
lbs. Wheat Bran, equal to dry matter,	112.05 "
lbs. Gluten Meal, equal to dry matter,	116.00 "
Total amount of dry matter,	473.89 lbs.

weight of animal at beginning of experiment,	33.0 lbs.
weight at time of killing,	178.3 "
weight gained during experiment,	145.3 "
sed weight at time of killing,	153.0 "
in weight by dressing,	25.3 lbs., or 14.2 per cent.
sed weight gained during experiment,	124.7 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn meal, at $24.00 per ton,	$1 79
gals. Skim-milk, at 1.8 cents per gallon,	2 29
lbs. Wheat Bran, at $22.50 per ton,	1 43
lbs. Gluten Meal, at $22.50 per ton,	1 43
	$6 94

bs. of dry matter fed yielded 1 lb. of live weight, and 3.80 lbs. of ry matter yielded 1 lb. of dressed weight.
of feed for production of 1 lb. of dressed pork, 5.6 cents.

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SUMMARY OF EXPERIMENTS III., IV.,

		Corn Meal (in lbs.).	Skim-milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight
III.	A,	406.0	303.0	55.0	55.0	2
	B,	475.0	303.0	74.0	74.0	2
IV.	C,	145.8	185.0	33.0	43.4	1
	D,	159.5	184.0	40.5	50.1	1
V.	E,	137.3	123.0	117.4	117.4	1
	F,	150.8	127.0	128.6	128.6	1
	G,	150.0	127.0	128.0	128.0	1
	H,	149.5	127.0	127.4	127.4	1
		1,773.9	1,479.0	703.9	703.9	1,2

Total Cost of Feed Consumed during the above-stated

1,773.9 lbs. Corn Meal, ...
1,479.0 gals. Skim-milk, ...
703.9 lbs. Wheat Bran, ...
723.9 lbs. Gluten Meal, ...

Average cost of feed for production of 1 lb. of dressed

Manurial Value of the Feed Consumed during the abo

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.
$7 07	$13 31	$4 75	$6 33

Total manurial value of feed for production of 1 lb.
2.91 cents.

SIXTH FEEDING EXPERIMENT (I, J, K,

Seven animals of a mixed breed were se
trial; their live weight varied from 40 to 60 p
them remained well; two became sick and d
the experiment.

The feeding began Feb. 17th, with a da
seven quarts of milk, twenty-one ounces of c
seven ounces each of wheat bran and glute
amount of skim-milk and corn meal remained
ing the entire trial, and a mixture of equal w
gluten meal and wheat bran supplied subsequ
creasing demand for feed. Seven quarts
twenty-one ounces of corn meal and twenty-

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stated mixture were fed daily to each animal, at the of the trial, May 2, 1887. The cost of feed con-ed, per pound of dressed pork produced, varied from to 4.32 cents. Taking the entire amount of dressed produced, during the experiment, into consideration, ost of feed per pound of dressed pork amounts to 5.69 . The amount of dry matter contained in the feed re-ed to produce one pound of dressed pork varied from to 4.15 pounds.

[I.]

RIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
to Mar. 3,	19.7	105.0	6.6	6.6	1:2.99	42.0	62.5	1 6
to Mar. 28,	32.8	175.0	16.4	16.4	1:3.13	62.5	98.5	1 7
to May 2,	61.3	245.0	16.6	16.6	1:3.23	98.5	126.5	0 13

Total Amount of Feed Consumed from Feb. 17 to May 2.

lbs. Corn Meal, equal to dry matter,	99.43 lbs.
qts. Skim-milk, equal to dry matter,	119.07 "
bs. Wheat Bran, equal to dry matter,	34.83 "
bs. Gluten Meal, equal to dry matter,	36.05 "
otal amount of dry matter,	289.38 lbs.
weight of animal at beginning of experiment,	42.0 lbs.
weight of animal at time of killing,	126.5 "
weight gained during experiment,	84.5 "
ed weight at time of killing,	104.4 "
n weight by dressing,	22.1 lbs. or 17.5 per cent.
ed weight gained during experiment,	69.7 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton,	$1 37
gals. Skim-milk, at 1.8 cents per gallon,	2 36
bs. Wheat Bran, at $22.50 per ton,	45
bs. Gluten Meal, at $22.50 per ton,	45
	$4 63

bs. of dry matter fed yielded 1 lb. of live weight, and 4.15 lbs. of ry matter yielded 1 lb. of dressed weight.

f feed for production of 1 lb. of dressed pork, 6.6 cents.

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[J.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of
1887.						
Feb. 17 to Mar. 3,	19.7	105.0	6.6	6 6	1:2.99	63
Mar. 4 to Mar. 28,	32.8	175.0	16.4	16.4	1:3.13	87
Mar. 29 to May 2,	61.3	245.0	16.6	16.6	1:3.23	123

Total Amount of Feed Consumed from Feb. 17 to

113.8 lbs. Corn Meal, equal to dry matter, . . .
525.0 qts. Skim-milk, equal to dry matter, . . .
39.6 lbs. Wheat Bran, equal to dry matter, . .
39.6 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment, .
Live weight of animal at time of killing, . . .
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, . . . 30.3 lbs.,
Dressed weight gained during experiment, . .

Cost of Feed Consumed during Experimen

113.8 lbs. Corn Meal, at $24.00 per ton, . . .
131.0 gals. Skim-milk, at 1.8 cents per gallon, . .
39.6 lbs. Wheat Bran at $22.50 per ton, . . .
39.6 lbs. Gluten Meal at $22.50 per ton, . . .

2.64 lbs. of dry matter fed yielded 1 lb. of live weight,
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.1

[K.]

Total Amount of Feed Consumed from Feb. 17 to

113.8 lbs. Corn Meal, equal to dry matter, . . .
525.0 qts. Skim-milk, equal to dry matter, . . .
39.6 lbs. Wheat Bran, equal to dry matter, . .
39.6 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

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eight of animal at beginning of experiment,	61.5 lbs.
eight of animal at time of killing,	145.0 "
eight gained during experiment,	83.5 "
l weight at time of killing,	119.6 "
weight by dressing	2.54 lbs., or 17.5 per cent.
l weight gained during experiment,	68.9 lbs.

Cost of Feed Consumed during Experiment.

s. Corn Meal, at $24.00 per ton,	$1 37
ls. Skim-milk, at 1.8 cents per gallon,	2 36
. Wheat Bran, at $22.50 per ton,	45
. Gluten Meal, at $22.50 per ton,	45
	$4 63

. of dry matter fed yielded 1 lb. of live weight, and 4.20 lbs. of matter yielded 1 lb. of dressed weight.

feed for production of 1 lb. of dressed pork, 6.72 cents.

[L.]

Total Amount of Feed Consumed from Feb. 17 to May 2.

s. Corn Meal, equal to dry matter,	99.43 lbs.
s. Skim-milk, equal to dry matter,	119.07 "
. Wheat Bran, equal to dry matter,	34.83 "
. Gluten Meal, equal to dry matter,	36.05 "
al amount of dry matter,	289.36 lbs.

eight of animal at beginning of experiment,	59.0 lbs.
eight of animal at time of killing,	143.5 "
eight gained during experiment,	84.5 "
l weight at time of killing,	118.4 "
weight by dressing,	25.1, or 17.5 per cent.
l weight gained during experiment,	69.7 lbs.

Cost of Feed Consumed during Experiment.

s. Corn Meal, at $24.00 per ton,	$1 37
ls. of Skim-milk, at 1.8 cents per gallon,	2 36
. Wheat Bran, at $22.50 per ton,	45
. Gluten Meal, at $22.50 per ton,	45
	$4 63

. of dry matter fed yielded 1 lb. of live weight, and 4.15 lbs. of matter yielded 1 lb. of dressed weight.

feed for production of 1 lb. of dressed pork, 6.64 cents.

[M.]

Total Amount of Feed Consumed from Feb. 17 to May 2.

s. Corn Meal, equal to dry matter,	99.43 lbs.
s. Skim-milk, equal to dry matter,	119.07 "
. Wheat Bran, equal to dry matter,	34.83 "
. Gluten Meal, equal to dry matter,	36.05 "
al amount of dry matter,	289.38 lbs.

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Live weight of animal at beginning of experiment, .
Live weight of animal at time of killing, . . .
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, . . . 30.8 lbs., o
Dressed weight gained during experiment, . .

Cost of Feed Consumed during Experiment

113.8 lbs. Corn Meal, at $24.00 per ton, ...
131.0 gals. Skim-milk, 1.8 cents per gallon, . . .
39.6 lbs. Wheat Bran, at $22.50 per ton, ...
39.6 lbs. Gluten Meal, at $22.50 per ton, ...

2.23 lbs. of dry matter fed yielded 1 lb. of live weight,
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.3

SUMMARY OF EXPERIMENT VI.

	Corn Meal (in lbs.).	Skim-milk (in gallons).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment
I, ...	113.8	131.0	39.6	39.6	84.
J, ...	113.8	131.0	39.6	39.6	109.
K, ...	113.8	131.0	39.6	39.6	83.
L, ...	113.8	131.0	39.6	39.6	84.
M, ...	113.8	131.0	39.6	39.6	130.
	569.0	655.0	198.0	198.0	492.

Total Cost of Feed Consumed during the above-stated

569.0 lbs. Corn Meal, ...
655.0 gals. Skim-milk, ...
198.0 lbs. Wheat Bran, ...
198.0 lbs. Gluten Meal, ...

Average cost of feed for production of 1 lb. of dressed p

Manurial Value of the Feed Consumed during the above

Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
$2 27	$5 94	$1 33	$1 73

Manurial value of feed for production of 1 lb. of
2.78 cents.

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Seventh Feeding Experiment.

en animals, crosses between White Chester and Black hire, served in this experiment. Their live weights from twenty-two to twenty-six pounds in case of dif- animals. The same fodder articles were used as in ird, fourth, fifth and sixth experiments; they were, er, fed in different proportions. The daily ration of neal was gradually increased during the progress of periment, for the purpose of altering the relative pro- n between the nitrogenous and non-nitrogenous matter feed. The relative proportion of one part of digesti- trogenous matter to two and nine-tenth parts of non- enous matter was changed at stated periods until it d 1 : 4.28.

Average of Daily Rations.

	Corn Meal (ounces).	Skim-milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).
July 11, ...	8.00	4	-	-
July 25, ...	12.00	6	-	-
July 28, ...	12.00	6	1.34	2.66
Aug. 8, ...	12.00	6	2.00	4.00
Aug. 15, ...	14.67	6	2.66	2.66
Aug. 23, ...	17.34	6	5.33	5.33
Aug. 29, ...	20.00	6	8.00	8.00
Sept. 12, ...	23.34	6	11.35	11.35
Sept. 26, ...	29.00	6	17.00	17.00
Oct. 11, ...	47.00	6	12.00	12.00
Oct. 27, ...	62.66	6	15.66	15.66

cost of feed consumed varied, in case of different s, from 4.80 to 5.49 cents per pound of dressed pork ed.

ing the entire lot of animals into consideration it ts to 5.15 cents per pound of dressed pork obtained. nount of dry matter contained in the feed required for oduction of one pound of dressed pork varied from 3.24 lbs.

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[N.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal
1887.						
June 28 to July 25,	17.50	140.0	–	–	1:2.91	2
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	4
Aug. 9 to Sept. 26,	68.59	294.0	31.83	31.83	1:3.39	6
Sept. 27 to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	13

Total Amount of Feed Consumed from June 28 t

202.93 lbs. Corn Meal, equal to dry matter, . .
704 qts. Skim-milk, equal to dry matter, . . .
60.04 lbs. Wheat Bran, equal to dry matter, . .
61.66 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment, .
Live weight at time of killing, ...
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, ... 41 lb
Dressed weight gained during experiment, . .

Cost of Feed Consumed during Experime

202.93 lbs. Corn Meal, at $24.00 per ton, . . .
176 gals. Skim-milk, at 1.8 cents per gallon, . .
60.04 lbs. Wheat Bran, at $22.50 per ton, . . .
61.66 lbs. Gluten Meal, at $22.50 per ton, . . .

2.51 lbs. of dry matter fed yielded 1 lb. of live weight
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.

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[O.]

IODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
887.								lb. oz.
to July 25,	17.50	140.0	-	-	1:2.91	23.50	44.00	0 11
o Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	44.00	61.00	1 3
o Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	61.00	125.00	1 5
to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	125.00	184.50	1 14

Total Amount of Feed Consumed from June 28 to Oct. 27.

lbs. Corn Meal, equal to dry matter, ...	176.53 lbs.
. Skim-milk, equal to dry matter, ...	126.72 "
os. Wheat Bran, equal to dry matter, ...	53.51 "
os. Gluten Meal, equal to dry matter, ...	55.62 "
tal amount of dry matter, ...	412.38 lbs.

eight of animal at beginning of experiment, . .	23.50 lbs.
eight at time of killing, ...	184.50 "
eight gained during experiment, ...	161.00 "
l weight at time of killing, ...	144.00 "
weight by dressing, ...	40.5 lbs., or 21 per cent.
l weight gained during experiment, ...	127.19 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton, ...	$2 44
s. Skim-milk, at 1.8 cents per gallon, ...	3 17
os. Wheat Bran, at $22.50 per ton, ...	68
os. Gluten Meal, at $22.50 per ton, ...	70
	$6 99

s. of dry matter fed yielded 1 lb. of live weight, and 3.24 lbs. of
y matter yielded 1 lb. of dressed weight.
feed for production of 1 lb. of dressed pork, 5.49 cents.

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[P.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal
1887.						
June 28 to July 25,	17.50	140.0	–	–	1:2.91	1
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	4
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	6
Sept. 27 to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	1

Total Amount of Feed Consumed from June 28

203.09 lbs. Corn Meal, equal to dry matter, . .
704 qts. Skim-milk, equal to dry matter, . . .
60.21 lbs. Wheat Bran, equal to dry matter, . .
61.83 lbs. Gluten Meal, equal to dry matter, . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment,
Live weight at time of killing, ...
Live weight gained during experiment, . . .
Dressed weight at time of killing, ...
Loss in weight by dressing, ... 41 lb
Dressed weight gained during experiment, . .

Cost of Feed Consumed during Experime

203.9 lbs. Corn Meal, at $24.00 per ton, . . .
176 gals. Skim-milk, at 1.8 cents per gallon, . .
60.21 lbs. Wheat Bran, at $22.50 per ton, . . .
61.83 lbs. Gluten Meal, at $22.50 per ton, . . .

2.37 lbs. of dry matter fed yielded 1 lb. of live weight
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5

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[Q.]

IODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in weight per day during period.
87.								lb. oz.
o July 25,	17.50	140.0	–	–	1:2.91	28.50	54.75	0 15
o Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	54.75	70.75	1 2
o Sept. 26,	68.41	294.0	31.67	31.67	1:3.34	70.75	143.00	1 8
o Oct. 25,	97.68	174.00	24.41	24.41	1:4.28	143.00	193.00	1 9

Total Amount of Feed Consumed from June 28 to Oct. 25.

lbs. Corn Meal, equal to dry matter, ...	168.70 lbs.
. Skim-milk, equal to dry matter, ...	124.56 "
os. Wheat Bran, equal to dry matter, ...	51.28 "
os. Gluten Meal, equal to dry matter, ...	53.37 "
tal amount of dry matter, ...	397.91 lbs.

eight of animal at beginning of experiment, . .	28.50 lbs.
eight at time of killing, ...	193.00 "
eight gained during experiment, ...	164.50 "
l weight at time of killing, ...	158.00 "
weight by dressing, ...	35 lbs., or 22 per cent.
l weight gained during experiment, ...	128.31 lbs.

Cost of Feed Consumed during Experiment.

lbs. Corn Meal, at $24.00 per ton, ...	$2 32
s. Skim-milk, at 1.8 cents per gallon, ...	3 11
os. Wheat Bran, at $22.50 per ton, ...	65
os. Gluten Meal at $22.50 per ton, ...	68
	$6 76

s. of dry matter fed yielded 1 lb. of live weight, and 3.10 lbs. of
y matter yielded 1 lb. of dressed weight.
feed for production of 1 lb. of dressed pork, 5.27 cents.

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[T.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.
1887.						
June 28 to July 25,	17.50	140.0	–	–	1:2.91	25.75
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	53.50
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	70.00
Sept. 27 to Oct. 25,	97.68	174.0	24.41	24.41	1:4.28	147.00

Total Amount of Feed Consumed from June 28 to O

194.43 lbs. Corn Meal, equal to dry matter, . . .
692 qts. Skim-milk, equal to dry matter, ...
58 04 lbs. Wheat Bran, equal to dry matter, . . .
59.66 lbs. Gluten Meal, equal to dry matter, . . .

Total amount of dry matter, ...

Live weight of animal at beginning of experiment, .
Live weight at time of killing, ...
Live weight gained during experiment, ...
Dressed weight at time of killing, ...
Loss in weight by dressing, ... 42 lbs., c
Dressed weight gained during experiment, . . .

Cost of Feed Consumed during Experiment.

194.43 lbs. Corn Meal, at $24.00 per ton, ...
173 gals. Skim-milk, at 1.8 cents per gallon, . . .
58.04 lbs. Wheat Bran, at $22.50 per ton, ...
59.66 lbs. Gluten Meal, at $22.50 per ton, ...

2.23 lbs. of dry matter fed yielded 1 lb. of live weight; a
dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.80 c

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SUMMARY OF EXPERIMENT VII.

	Corn Meal (in lbs.).	Skim-milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per pound of Dressed Pork (cents).
. . . . .	202.93	176.0	60.04	61.66	163.75	129.36	5.39
. . . . .	203.09	176.0	60.21	61.83	161.00	127.19	5.49
. . . . .	203.00	176.0	60.21	61.83	174.00	139.20	5.02
. . . . .	194.09	173.0	57.71	59.93	164.50	128.31	5.27
. . . . .	194.43	173.0	58.04	59.66	177.50	138.45	4.89
. . . . .	194.43	173.0	58.04	59.66	162.50	128.38	5.26
. . . . .	194.43	173.0	58.04	59.66	178.25	140.83	4.80
	1,386 40	1,220.0	412.29	424.23	1,181.50	931.74	–

otal Cost of Feed consumed during the above-stated Experiment.

40 lbs. Corn Meal, ...	$16 64
0 gals. Skim-milk, ...	21 96
0 lbs. Wheat Bran, ...	4 64
3 lbs. Gluten Meal, ...	4 77
	$48 01

ge cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

nurial Value of the Feed consumed during the above Experiment.

eal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
2	$11 32	$2 97	$3 71	$23 52

rial value of feed for production of 1 lb. of dressed pork, 2.52 ents.

king for granted that in raising one and the same kind nimals to corresponding weights, practically the same unt of nitrogen, phosphoric acid, potassa, etc., will be ned in the animal system, it follows that the excess of one of these constituents of one diet as compared with her one must count in favor of the higher commercial e of the manurial residue of that particular diet.

ccepting this view regarding the final determination of cost of feed as correct, it will be noticed, in the subse-

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quent summary of our previously described six
periments, that an addition of gluten meal and v
a diet consisting of skim-milk and corn meal,
cost of dressed pork, in consequence of the hig
the manurial refuse obtained. As we sold our
for from 5½ to 7½ cents per pound, we received
3.5 cents for labor, housing, etc.

Our seventh feeding experiment has given
satisfactory pecuniary results; for the net cost
sumed amounted to 3.39 cents per pound of
produced, after allowing a loss of thirty per
manurial value of the feed, in consequence of t
the animal.

SUMMARY OF EXPERIMENTS II., III., IV., V., V

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (lbs.).	Cost of Feed per pound of Dressed Pork (cents).	Manurial Value of Feed per pound of Dressed Pork
II.,	3.31	5.51	2.30
III., IV., V.,	3.86	5.92	2.91
VI.,	3.56	5.69	2.78
VII.,	3.07	5.15	2.52

Valuation of Essential Fertilizing Constituents con
Various Articles of Fodder used.

	PER C	
	Corn Meal.	Skim-milk.
Moisture,	10.00	90.00
Nitrogen (17 cents per pound),	1.96	0.55
Phosphoric acid (6 cents per pound),	0.77	0.17
Potassium oxide (4½ cents per pound),	0.45	0.20
Valuation per 2,000 pounds,	$7 97	$2 25

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Average Analysis of Skim-milk.

	Per cent.
ture at 100° C.,	89.78
Matter,	10.22
	100.00

Analysis of Dry Matter.

(Mineral Matter),	7.82
	3.23
ein (Nitrogenous Matter),	34.54
-nitrogenous Extract Matter,	54.40
	100.00

Nutritive Ratio, 1 : 1.8.

he skim-milk contained 10.22 per cent. of solids; one rt of it weighed 35.5 ounces, and contained 3.63 ounces olids; one gallon contained 14.52 ounces of dry organic ter.

sed in the second, third, fourth, fifth and sixth experi-ts.

SKIM-MILK.

[Average of two Analyses.]

	Per cent.
ture at 100° C.,	91.00
Matter,	9.00
	100.00

Analysis of Dry Matter.

(Mineral Matter),	6.67
	2.78
ein (Nitrogenous Matter),	34.00
-nitrogenous Extract Matter,	56.55
	100.00

Nutritive Ratio, 1 : 1.86.

sed in the seventh feeding experiment.

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GLUTEN MEAL.

99.82 per cent. passed through Mesh 144 to square

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	8.45	169.00	–
Dry Matter,	91.55	1,831.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	0.76	15.20	–
" Cellulose,	1.73	34.60	11.76
" Fat,	9.34	186.80	141.97
" Protein (Nitrogenous Matter),	35.31	706.20	600.27
Non-nitrogenous Extract Matter,	52.86	1,057.20	993.76
	100.00	2,000.00	1,747.76

Used in the third experiment.

GLUTEN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	8.95	179.00	–
Dry Matter,	91.05	1,821.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	0.76	15.20	–
" Cellulose,	1.58	31.60	10.74
" Fat,	7.51	150.20	114.15
" Protein (Nitrogenous Matter),	30.81	616.20	523.77
Non-nitrogenous Extract Matter,	59.34	1,186.80	1,115.59
	100.00	2,000.00	1,764.25

Used in the fourth, fifth and sixth experiments.

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GLUTEN MEAL.

91.44 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
isture at 100° C., . . .	10.04	200.80	–	–	1 : 2.27
y Matter, ...	89.96	1,799.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
ude Ash, ...	0.78	15.60	–	–	
" Cellulose, ...	4.45	89.00	30.26	34	
" Fat, ...	9.34	186.80	141.96	76	
" Protein (Nitrogenous Matter), . . .	34.67	693.40	589.59	85	
n-nitrogenous Extract Matter, ...	50.76	1,015.20	954.29	94	
	100.00	2,000.00	1,716.10	–	

Used in the seventh feeding experiment.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
isture at 100° C., . . .	12.62	252.40	–	–	1 : 8.76
y Matter, ...	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
ude Ash, ...	1.56	31.20	–	–	
" Cellulose, ...	2.66	53.20	18.09	34	
" Fat, ...	4.27	85.40	64.90	76	
" Protein (Nitrogenous Matter), . . .	11.43	228.60	194.31	85	
n-nitrogenous Extract Matter, ...	80.08	1,601.60	1,505.50	94	
	100.00	2,000.00	1,782.80	–	

Used in the second, fourth, fifth and sixth experiments.

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CORN MEAL.

93.28 per cent. passed through Mesh 144 to squar

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	11.95	239.00	–
Dry Matter,	88.05	1,761.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	1.59	31.80	–
" Cellulose,	2.59	51.80	17.61
" Fat,	4.43	88.60	67.34
" Protein (Nitrogenous Matter),	13.13	262.60	223.21
Non-nitrogenous Extract Matter,	78.26	1,565.20	1,471.29
	100.00	2,000.00	1,779.45

Used in the third feeding experiment.

CORN MEAL.

[Average of two Analyses.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	13.08	261.60	–
Dry Matter,	86.92	1,738.40	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	1.66	33.20	–
" Cellulose,	3.49	69.80	23.73
" Fat,	4.97	99.40	75.54
" Protein (Nitrogenous Matter),	10.39	207.80	176.63
Non-nitrogenous Extract Matter,	79.49	1,589.80	1,494.41
	100.00	2,000.00	1,770.41

Used in the seventh feeding experiment.

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WHEAT BRAN.

81.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
ture at 100° C., . . .	12.05	241.00	–	–	1 : 3.77
Matter, ...	87.95	1,729.00	–	–	
	100.00	2,000.00	–	–	
alysis of Dry Matter.					
e Ash, ...	6.64	132.80	–	–	
Cellulose, ...	11.49	229.80	45.96	20	
Fat, ...	4.75	95.00	76.00	80	
Protein (Nitrogenous Matter), . . .	17.86	357.20	314.34	88	
nitrogenous Extract tter, ...	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,384.46	–	

sed in the third, fourth, fifth and sixth experiments.

WHEAT BRAN.

73.36 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
ure at 100° C., . . .	11.14	222.80	–	–	1 : 3.85
Matter, ...	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
alysis of Dry Matter.					
e Ash, ...	6.59	131.80	–	–	
Cellulose, ...	12.80	256.00	51.20	20	
Fat, ...	6.00	120.00	96.00	80	
Protein (Nitrogenous Matter), . . .	17.72	354.40	311.87	88	
nitrogenous Extract tter, ...	56.89	1,137.80	910.04	80	
	100.00	2,000.00	1,369.11	–	

sed in the seventh feeding experiment.

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ON FODDER SUPPLY, AND A
OF FODDER ARTICLES.

On Fodder Supply.

The practice of raising a greater variety of va
for green fodder deserves the serious considerat
ers engaged in the dairy business, for it secu
supply of healthy, nutritious fodder, at a time
becomes scarce and costly, and when it woul
wasteful practice to feed an imperfectly matured
der corn. The frequently limited area of la
remunerative production of grasses, and the not
nized exhausted condition of a large proportio
pastures, makes it but judicious to consider s
means which promise, not only to increase,
cheapen, the products of the dairy.

A liberal introduction of reputed forage cro
operations has, everywhere in various direction
the success of agricultural industry. The desira
troducing a greater variety of fodder plants in
management is generally conceded. In choosi
that purpose, it seems advisable to select crops
advantageously supplement our leading fodder
from the products of pastures and meadows), —
corn and corn stover.

Taking this view of the question, the great a
family of leguminous plants, as clovers, vetch
serradella, peas, beans, lupines, etc., is, in a p
gree, well qualified for that purpose. They de
decided recommendation in the interest of a
for the introduction of economical systems o
under various conditions of soil, and different

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rkets. Most of these fodder plants have an extensive ystem, and, for this reason, largely draw their plant- from the lower portion of the soil. The amount of le and roots they leave behind after the crop has been sted is exceptionally large, and decidedly improves he physical and chemical condition of the soil. The are consequently better fitted for the production of w-growing crops, as grains, etc. Large productions lder crops assist in the economical raising of general crops; although the area devoted to the cultivation of tter is reduced, the total yield of the land is usually satisfactory.

e of the foremost experts in stock-feeding, Julius of Halle, Germany, expressed the whole question e following terse manner: "Much fodder, — much re, large crops and more money in the end."

ch farmer ought to make his selection, from among the us fodder plants, to suit his individual resources and ; yet, adopting this rule as his guide, he ought to make lection on the basis that the crop which is capable of cing, for the same area, the largest quantity of nitro- - containing food constituents, at the least cost, is, as , the most valuable one for him.

r prominent fodder plants may be classified, in regard relative proportion of their *nitrogenous* organic food tuents to their *non-nitrogenous* organic food con- nts (nutritive ratio), in the following order: —

guminous plants, clover, vetch, etc., ...	1:2.2 to 1:4.5
asses, ...	1:5.0 to 1:8.0
een corn, roots and tubers, ...	1:6.0 to 1:15.0

value of an article of fodder may be stated from two nt stand-points, — that is, with reference to its cost in cal market, and with reference to its nutritive feeding * The market price may be expressed by a definite or each locality; it depends on demand and supply in arket, and it is beyond the control of the individual r. The nutritive value, or, commonly called, food

* details regarding estimation of nutritive ratio, see article on "Fodder and Analysis," Page 31-37, Fourth Annual Report.

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value, of the article cannot be expressed by a d
it varies with a more or less judicious applicati
pends also, to a considerable degree, on its adap
varying circumstances.

To secure the most satisfactory returns from
home-raised fodder crops, is as important a ques
of raising them in an economical manner. T
whether one or the other fodder mixture will
mately, under otherwise corresponding circum
cheapest one, can only be answered intelligently
the original cost of the feed consumed, and the
manurial residue subsequently obtained, are duly

The composition of the various articles of f
farm practice exerts a decided influence on t
value of the animal excretions, resulting from t
the diet of different kinds of farm live-stock.
potash, phosphoric acid, and, in particular, nitr
der contains, the more valuable will be, unde
corresponding circumstances, the manurial
behind, after it has served its purpose as a consti
food consumed.

As the financial success in most farm manageme
in a considerable degree, on the amount, the c
the cost of the manurial refuse material secured
tion with the special farm industry carried on,
further argument to prove that the relations
between the composition of the fodder and the
manure resulting deserves the careful considera
farmer, when devising an efficient and at the sa
economical diet for his live-stock.

Fodder Corn and Corn Ensilage.

In the fourth annual report on the work of the
Station, it was stated that a series of tests carri
plants taken from our fields had demonstrated t
the vegetable matter in the variety of corn on t
had increased from fifty to one hundred per cen
weight between the time of the first appearance
and the beginning of the kernels to glaze. It

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the same variety of corn, raised under fairly corre-
ding circumstances, as far as the general character of the
nd the mode of cultivation are concerned, contained, in
undred weight parts, at the time of the *first appearance*
tassel, from *twelve to fifteen* weight parts of dry vege-
matter, and from *eighty-five* to *eighty-eight* parts of
; while at the time of the *beginning of the glazing of*
ernels, the former was noticed to vary from *twenty-three*
enty-eight weight parts, and the water from *seventy-*
to *seventy-two*. These results of our investigation left
oubt concerning the fact that our green fodder corn, at
ime of the beginning of the glazing of the kernels,
ined nearly twice as much vegetable matter per ton
nt of corn as at the time of the appearance of the
ls.

is feature in the change of the composition of the
r corn during its growth is not an exceptional one;
ar changes are noticed in all our farm plants. Our ob-
tions in this direction were reported for the purpose
rnishing some more definite numerical values for the
deration of our practical farmers. As long as the vital
y of an annual plant is still essentially spent in the
ase of its size, as a rule, but a comparatively small
nt of valuable organic compounds, as starch, sugar,
accumulate within its cellular tissue. The comparative
ng value of the same kind of fodder plants, or any par-
r part of such plants, is not to be measured by its size,
y the quantity of valuable organic nitrogenous and
itrogenous constituents stored up in its cellular system.
larger or smaller amount of dry vegetable matter left
d from a given weight of samples of the same kind, of
der plant of a corresponding stage of growth, indicates,
e majority of cases, their respective higher or lower
mical value for feeding purposes. Agricultural chem-
for this reason, usually begin their examination of a
r plant with a test for the determination of the amount
y vegetable matter left behind when carefully brought
constant weight at a temperature not exceeding 110° C.
e amount of vegetable matter in a given weight of green
r corn, cut at the *beginning of the glazing of the kernels*,

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is known to be not only nearly *twice* as large,
with that contained in an *equal weight of green*
when just showing the *tassels*, but it is also k
pound for pound, more nutritious; for it co
starch, more sugar, more of valuable nitrogenou

Accepting these views as correct, our silos hav
for several years past, with fodder corn wh
reached the stage of growth when the kernels b
over. The condition of the plants along the o
corn-field served as guides. These plants are, as
advanced in growth than those in the more pro
of the field.

The fodder corn, when cut for the silo, Se
to acquire a slightly yellowish tint along th
the field, yet was still green and succulent in
parts; the kernels were soft, their contents som
and their outside just beginning to glaze.

A silo, five by fourteen feet, inside measure
feet deep, was filled to a depth of from eight
as fast as the cut corn, 1¼ to 1½ inches lo
supplied and tramped down. As soon as th
corn assigned for that silo (9 tons) was filled in
was carefully covered with tarred paper and
boards, in the same manner as in the case of t
and at once pressed down with twenty-five bar
A maximum registering thermometer was safely
depth of about three feet in the mass, to recor
temperature which the latter would reach durin
keeping the silo closed.

The silo was re-opened for feeding, Jan. 4,
record of the maximum thermometer buried
tre of the silo showed 97° F., indicating but
crease in temperature, as compared with the te
the day when filled. The ensilage was of a g
A comparison with the composition of the green
which served for its manufacture, shows the u
noticed in a silo which has been filled at once
carefully without any material delay, to pre
serious heating up of its contents; namely, a
nitrogenous matter and crude cellulose, and an

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acids and soluble non-nitrogenous extract matter. The ive ratio of the fodder corn was but slightly altered. ample of the corn ensilage, taken from two feet below rface, near the centre of the silo, contained 32.46 parts matter, 0.0185 parts of actual ammonia, and required milligrams of sodium oxide for the neutralization of ds (acetic and lactic acids). An average sample of silage served for the analysis below reported.

en Fodder Corn, used for Ensilage in 1886 (Clark variety).
rn Ensilage, obtained from the above-described Fodder Corn.

	Pounds per Hundred.	
	I.	II.
re at 100° C.,	70.27	71.60
tter,	29.73	28.40
	100.00	100.00
Analysis of Dry Matter.		
Ash,	5.24	3.32
Cellulose,	24.50	18.52
Fat,	3.38	6.07
Protein (Nitrogenous Matter),	8.36	7.78
rogenous Extract Matter,	58.52	64.31
	100.00	100.00

is of Green Fodder Corn and Corn Ensilage, with Reference to Fertilizing Constituents.

	Pounds per Hundred.	
	Green Fodder Corn.	Corn Ensilage.
re at 100° C.,	70.27	71.60
oric acid (6 cents per pound),	0.13	0.14
xide,	–	0.02
sium oxide,	0.05	0.09
n oxide,	0.18	0.10
um oxide (4¼ cents per pound),	0.36	0.33
oxide,	0.05	0.05
n (17 cents per pound),	0.41	0.36
le matter,	0.45	0.04
on per 2,000 pounds,	$1 86	$1 68

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The corn was raised upon land which l
several years fertilized with ground bone ar
potash, 600 pounds of ground bone and 20
muriate of potash being applied.

The ensilage has been used with satisfactory
feeding experiments with milch cows, I., which
in the beginning of this report.

The silo was filled again with fodder corn
Sept. 5, 1887. The same rules were carried
occasion as in the preceding year. A max
minimum recording thermometer has been b
feet below the surface of the cut corn, to s
in temperature, etc. The ensilage will be
repetition of our feeding experiments, under s
circumstances.

1. FODDER OATS.

[Grown at the Experiment Station on well-manured land. Co
(in bloom).]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture when collected,	78.61	1,572.00	–
Dry Matter when collected,	21.39	427.80	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	7.38	147.60	–
" Cellulose,	33.12	662.40	–
" Fat,	2.02	40.40	18.5
" Protein (Nitrogenous Matter),	7.10	142.00	80.9
Non-nitrogenous Extract Matter,	50.38	1,007.60	1,007.6
	100.00	2,000.00	1,107.1

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2. FODDER OATS.

wn at the Experiment Station on well-manured land. Collected July 13, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
ture when collected,	71.18	1,423.60	–	–	1 : 13.32
Matter when collected,	28.82	576.40	–	–	
	100.00	2,000.00	–	–	
alysis of Dry Matter.					
e Ash,	6.99	139.80	–	–	
Cellulose,	32.83	656.60	–	–	
Fat,	2.44	48.80	22.45	46	
Protein (Nitrogenous Matter),	7.05	141.00	80.38	57	
nitrogenous Extract tter,	50.69	1,013.80	1,013.80	100	
	100.00	2,000.00	1,116.63	–	

ROWEN (HAY).

ed on Station Grounds, 1887. Contained a liberal admixture of Red Clover.]

	Per cent.
ture at 100° C.,	8.84
Matter,	91.16
	100.00

Analysis of Dry Matter.

e Ash,	10.50
Cellulose,	29.46
Fat,	3.05
Protein (Nitrogenous Matter),	13.20
nitrogenous Extract Matter,	43.79
	100.00

Fertilizing Ingredients of Rowen.

	Per cent.
ure at 100° C.,	8.840
phoric acid,	.364
sium oxide,	2.860
gen,	1.930
m oxide,	.122
um oxide,	.853
esium oxide,	.197
e oxide,	.057
uble Matter,	2.178

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SERRADELLA.

[Grown at the Experiment Station. Collected when in bloom

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture when collected,	84.60	1,692.00	–
Dry Matter when collected,	15.40	308.00	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	11.85	237.00	–
" Cellulose,	26.21	524.20	–
" Fat,	2.65	53.00	31.80
" Protein (Nitrogenous Matter),	17.75	355.00	223.65
Non-nitrogenous Extract Matter,	41.54	830.80	830.80
	100.00	2,000.00	1,086.25

Analysis of Serradella, with Reference to Fertilizing

Moisture at 100° C.,
Phosphoric acid (6 cents per pound),
Potassium oxide (4¼ cents per pound),
Magnesium oxide,
Calcium oxide,
Sodium oxide,
Nitrogen (17 cents per pound),
Insoluble Matter,

Valuation per 2,000 pounds,

This plant has been described in previous re
valuable fodder plant, adapted to moist, sandy l
feeding value has been tested at the Station during
year.

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WHITE DAISY (LEUCANTHEMUM VULGARE).

(Dried.)

	Per cent.
ture at 100° C.,	9.65
Matter,	90.35
	100.00

Analysis of Dry Matter.

e Ash,	7.05
Cellulose,	36.09
Fat,	2.32
Protein (Nitrogenous Matter),	7.68
nitrogenous Extract Matter,	46.86
	100.00

Fertilizing Ingredients of White Daisy.

ure at 100° C.,	9.65
phoric acid,	.435
sium oxide,	1.253
gen,	1.110
m oxide,	1.636
nm oxide,	1.302
nesium oxide,	.198
uble Matter,	.279
ation per 2,000 lbs.,	$5 36

"PRIDE OF THE NORTH" CORN.

[Raised at the Experiment Station, 1886.]

verage length of ear, seven inches, containing fourteen of kernels. The ear was well filled-out at the butt. rage weight of the corn and cob was six ounces, consist- of 84 per cent. of kernels and 16 per cent. of cob. rage weight of kernels, .24 gramme.

	Per cent.
ure at 100° C.,	8.75
Matter,	91.25
	100.00

Analysis of Dry Matter.

Ash,	1.59
Cellulose,	2.54
Fat,	4.34
Protein (Nitrogenous Matter),	12.05
nitrogenous Extract Matter,	79.48
	100.00

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The seed corn came from the Department of at Washington, D. C.; it had been obtained fro The corn was raised at the Station lands in goo with 600 pounds of ground bones and 200 poun of potash per acre, as fertilizer. The plant b "Dent" variety, and deserves recommendation our section of the State. The composition o is above the average. The stalks are, howeve harder than many of our local varieties.

"WESTERN DENT" CORN.

[Sent on from Sunderland, Mass.]

	Ears
Moisture at 100° C.,	10.2
Dry Matter,	89.8
	100.0
Analysis of Dry Matter.	
Crude Ash,	1.4
" Cellulose,	1.8
" Fat,	4.7
" Protein (Nitrogenous Matter),	9.3
Non-nitrogenous Extract Matter,	82.6
	100.0

The above-stated corn was raised, according received, on excellent soil in "Sunderland Mea cords of barnyard manure and 150 pounds of fertilizer per acre had been applied.

6 stalks, well air-dried, weighed	2
6 ears, well air-dried, weighed	2

The average length of the ear was seven a inches. It contained twelve rows of kernels, an weight amounted to six and one-half ounces; 85 kernels, and 14.4 per cent. cob.

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"CANADA" CORN (KERNELS).

[Sent on from North Amherst, Mass.]

	Per cent.
isture at 100° C.,	9.76
y Matter,	90.24
	100.00

Analysis of Dry Matter.

ude Ash,	1.77
" Cellulose,	2.18
" Fat,	6.39
" Protein (Nitrogenous Matter),	11.50
n-nitrogenous Extract Matter,	78.16
	100.00

The above-stated corn was grown on heavy, dry loam, tilized with nine cords of barnyard manure and hog nure to the acre.

8 ears, well air-dried, weighed	1 lb., 13 oz.
5 stalks, well air-dried, weighed	1 " 4 "

The average length of the ear was six and one-third inches. contained eight rows of kernels, and its average weight ounted to three and three-fourths ounces; 85.07 per nt. kernels, and 14.93 per cent. cob. The average weight a kernel was .34 gramme. The yield per acre at harvest ne was 5,063.5 pounds of ears.

ADAM'S WHITE CORN.

[Sent on from North Amherst, Mass.]

	Per cent.
isture at 100° C.,	10.96
y Matter,	89.04
	100.00

Analysis of Dry Matter.

ude Ash,	1.56
" Cellulose,	2.22
" Fat,	5.37
" Protein (Nitrogenous Matter),	8.88
n-nitrogenous Extract Matter,	81.97
	100.00

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The above-stated corn was grown on light, sandy fertilized with four cords of barnyard manure and thi bushels of unleached ashes per acre.

6 ears, well air-dried, weighed	2 lbs.,
6 stalks, well air-dried, weighed	1 "

The average length of ear was eight and one- inches. It contained twelve rows of kernels, and its weight amounted to six ounces; 72.2 per cent. kerne 27.8 per cent. cob. The average weight of a kernel gramme. The yield per acre at harvest time was pounds of ears.

BROOM-CORN SEED (UNGROUND).

[Sent on from North Hadley, Mass.]

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

BROOM-CORN SEED MEAL.

70.26 per cent. passed screen 144 mesh to square inch.

[Sent on from North Hadley, Mass.]

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

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BROOM-CORN WASTE (Stalks)

[Sent on from North Hadley, Mass.]

	Per cent.
oisture at 100° C.,	8.70
y Matter,	91.30
	100.00

Analysis of Dry Matter.

ude Ash,	4.88
" Cellulose,	39.25
" Fat,	1.00
" Protein (Nitrogenous Matter),	6.78
n-nitrogenous Extract Matter,	48.09
	100.00

Fertilizing Ingredients of Broom-Corn Waste.

oisture at 100° C.,	10.374
osphoric acid (6 cents),	.460
tassium oxide (4¼ cents),	1.858
trogen (12 cents),	.870
lcium oxide,	.242
gnesium oxide,	.170
oluble Matter,	.997
luation per ton of 2,000 pounds,	$4 13

PEA MEAL.

[Sent on from Springfield, Mass.]

63.88 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
isture at 100° C.,	8.85	177.00	–	–	1 : 2.98
y Matter,	91.15	1,823.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
ude Ash,	2.94	58.80	–	–	
" Cellulose,	19.42	388.40	–	–	
" Fat,	1.67	33.40	26.72	80	
" Protein (Nitrogenous Matter),	20.95	419.00	368.72	88	
n-nitrogenous Extract Matter,	55.02	1,100.40	1,034.38	94	
	100.00	2,000.00	1,429.82	–	

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The above material comes from parties enga
manufacture of split peas. It is evidently a
ground peas with a liberal admixture of groun
peas. The article is offered in Springfield at twe
per ton. The well-known highly nutritious qua
peas renders a trial advisable.

Analysis of Pea Meal, with Reference to its Fertilizing

Moisture at 100° C.,	
Ferric oxide,	
Phosphoric acid (6 cents per pound),	
Magnesium oxide,	
Calcium oxide,	
Potassium oxide (4¼ cents per pound),	
Sodium oxide,	
Nitrogen (17 cents per pound),	
Insoluble matter,	
Valuation per 2,000 pounds,	

GLUTEN MEAL (CHICAGO).

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C.,	10.04	200.80	–
Dry Matter,	89.96	1,799.20	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash,	.78	15.60	–
" Cellulose,	4.45	89.00	30.26
" Fat,	9.34	186.80	141.97
" Protein (Nitrogenous Matter),	34.67	693.40	589.39
Non-nitrogenous Extract Matter,	50.76	1,015.20	954.29
	100.00	2,000.00	1,715.91

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WHEAT BRAN.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
isture at 100° C., . . .	10.38	207.60	–	–	1 : 4.17
Matter, ...	89.62	1,792.40	–	–	
	100.00	2,000.00	–	–	
nalysis of Dry Matter.					
de Ash, ...	6.92	138.40	–	–	
Cellulose, . . .	14.26	285.20	57.04	20	
Fat, ...	4.81	96.20	76.96	80	
Protein (Nitrogenous Matter), . . .	16.25	325.00	286.00	88	
n-nitrogenous Extract Iattter, ...	57.76	1,155.20	924.16	80	
	100.00	2,000.00	1,344.16	–	

WHEAT BRAN (1886).

[Fine Ground.]

94.95 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
sture at 100° C., . .	12.20	244.00	–	–	1 : 3.16
Matter, ...	87.80	1,756.00	–	–	
	100.00	2,000.00	–	–	
nalysis of Dry Matter.					
de Ash, ...	7.33	146.60	–	–	
Cellulose, . . .	10.92	218 40	43.68	20	
Fat, ...	2.80	56.00	44.80	80	
Protein (Nitrogenous Matter), . . .	19.79	395.80	348.30	88	
n-nitrogenous Extract Iatter, ...	59.16	1,183.20	946.56	80	
	100.00	2,000.00	1,383.34	–	

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Analysis of Wheat Bran, with reference to Fertilizing

Moisture at 100° C., ...
Phosphoric acid (6 cents per pound), ...
Magnesium oxide, ...
Calcium oxide, ...
Potassium oxide, (4¼ cents per pound), ...
Sodium oxide, ...
Nitrogen (17 cents per pound), ...
Insoluble matter, ...

Valuation per 2,000 pounds, ...

WHEAT MIDDLINGS.

[Amherst Mill.]

99.51 per cent. passed through Mesh 144 to squar

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.
Moisture at 100° C., . .	9.54	190.80	–
Dry Matter, ...	90.46	1,809.20	–
	100.00	2,000.00	–
Analysis of Dry Matter.			
Crude Ash, ...	4.47	89.40	–
" Cellulose, ...	5.64	112.80	22.56
" Fat, ...	6.00	120.00	96.00
" Protein (Nitrogenous Matter), . .	19.45	389.00	342.32
Non-nitrogenous Extract Matter, ...	64.44	1,288.80	1,031.04
	100.00	2,000.00	1,491.92

Analysis of Wheat Middlings, with reference to Constituents.

Moisture at 100° C., ...
Phosphoric acid (6 cents per pound), ...
Ferric oxide, ...
Magnesium oxide, ...
Calcium oxide, ...
Potassium oxide (4¼ cents per pound), ...
Sodium oxide, ...
Nitrogen (17 cents per pound), ...
Insoluble matter, ...

Valuation per 2,000 pounds, ...

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CORN MEAL.

92.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
ture at 100° C., . . .	11.68	233.60	–	–	1 : 7.50
Matter, ...	88.32	1,766.40	–	–	
	100.00	2,000.00	–	–	
alysis of Dry Matter.					
e Ash, ...	1.56	31.20	–	–	
Cellulose, . . .	2.44	48.80	16.59	34	
Fat, ...	4.73	94.60	71.89	76	
Protein (Nitrogenous Matter), . .	10.34	206.80	175.78	85	
nitrogenous Extract tter, ...	80.93	1,618.60	1,121.48	94	
	100.00	2,000.00	1,385.74	–	

CORN MEAL.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
ure at 100° C., . . .	12.98	259.60	–	–	1 : 10.01
Matter, ...	87.02	1,740.40	–	–	
	100.00	2,000.00	–	–	
alysis of Dry Matter.					
e Ash, ...	1.75	35.00	–	–	
Cellulose, . . .	3.42	68.40	23.26	34	
Fat, ...	5.08	101.60	77.22	76	
Protein (Nitrogenous Matter), . .	10.07	201.40	171.19	85	
nitrogenous Extract tter, ...	79.68	1,593.60	1,497.98	94	
	100.00	2,000.00	1,769.65	–	

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CORN MEAL.

[Amherst Mill.]

	Percentage Composition.	Constituents (In lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of
Moisture at 100° C.,	13.18	263.60	-
Dry Matter,	86.82	1,736.40	-
	100.00	2,000.00	-
Analysis of Dry Matter.			
Crude Ash,	1.57	31.40	-
" Cellulose,	3.56	71.20	24.
" Fat,	4.86	97.20	73.
" Protein (Nitrogenous Matter),	10.72	214.40	182.
Non-nitrogenous Extract Matter,	79.29	1,585.80	1,490.
	100.00	2,000.00	1,770.

CRACKED CORN (CHITS REMOVED)

[Sent on from North Hadley, Mass.]

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

CHIT CORN MEAL.

80.65 per cent. passed screen 144 Mesh to squa

[Sent on from North Hadley, Mass.]

Moisture at 100° C., ...
Dry Matter, ...

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Analysis of Dry Matter.

	Per cent.
rude Ash,	2.08
" Cellulose,	3.92
" Fat,	5.74
" Protein (Nitrogenous Matter),	10.26
on-nitrogenous Extract Matter,	78.00
	100.00

ENSILAGE OF SWEET CORN.

[Sent on from Marblehead, Mass.]

Analysis of Dry Matter.

	Per cent.
rude Ash,	5.66
" Cellulose,	24.21
" Fat,	5.19
" Protein (Nitrogenous Matter),	10.10
on-nitrogenous Extract Matter,	54.84
	100.00

The general appearance of the ensilage was good. The nall amount of soluble non-nitrogenous matter, in presence f a comparatively large amount of crude nitrogenous matter nd of crude cellulose, seems to indicate a considerable de-ruction of non-nitrogenous matter (sugar, starch, etc.) uring the keeping of the corn in the silo. The composition f this sample of ensilage of sweet corn resembles that ob-ined from corn in the tassel. A comparison of the above nalysis with some of the analyses of the dry vegetable atter of corn ensilage, produced at the Experiment Station uring previous years, suggests that conclusion.

ANALYSES OF FINE SALT.

[I. and II. sent on from Florida, Berkshire County, Mass. III. sent on from Springfield, Mass.]

	Per Cent.		
	I.	II.	III.
oisture at 100° C.,	3.280	4.591	4.616
dium chloride,	95.091	94.012	94.236
lcium sulphate,	1.487	1.177	0.999
lcium chloride,	0.032	0.143	0.071
agnesium chloride,	0.075	0.049	0.026
atter insoluble in water (largely carbon-ates of lime and magnesia),	0.035	0.028	0.052
licylic acid,	0.	0.	trace.
	100.000	100.000	100.000

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The above-described samples of salt have bee
late in our markets as "dairy salt," judging fro
cations received. As the recent introduction i
kets of various brands of salt from new salt work
New York imparts a particular interest to the
what constitutes a good dairy salt, a short discus
question may not be without interest in connecti
above analyses.

There are three sources of supply for the ma
salt; namely, sea water, brines and rock salts
them yield by any current mode of manufacture
pure article of sodium chloride; all three may
fully turned to account for the manufacture of
brands of salt in our market.

Local circumstances control the selection of th
source of supply; and, as the particular fitness
different domestic applications, as meat-packing,
and dairy, depends not only on a fairly good ch
position, but also to a considerable degree on
mechanical condition, it is quite obvious that the
the mode of manufacture has to be made with
the general character and the quality of the sour
and to the kind of salt desired.

Our home-manufactured salt — "coarse," "
"dairy salt" — has been produced, until of late,
tirely from natural brines, sea-water excluded.
brines contain more or less of foreign saline
Most prominent among these are the sulphates
magnesia, and the chlorides of calcium and magn

The general character and the industrial value
brines, considering concentration equally favora
as a rule not so much on the total amount of fo
substances present, as on the relative proportion o
stated foreign admixtures.

The same circumstances apply with equal force
produced. The less chlorides of calcium and m
salt contains, the better will be considered its qua
commercial stand-point. The presence of sulph
within certain limits, is far less objectionable.

A salt which contains but one-fourth of one

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chlorides of magnesium and of calcium, might prove hly objectionable to the dairyman, on account of its unasantly bitter saline taste; while the sulphate of lime ely amounts to less than one and one-quarter per cent. in best-reputed brands of dairy salts, home and foreign.

A detailed statement of the exact amount of each of the ve-mentioned foreign saline admixtures is for this reason ded, to render a decision possible regarding the relative its of the various brands of salt offered for sale, as far as esirable composition is concerned.

The most common cause of injuring the composition of , for dairy purposes in particular, is a too liberal use of e during its manufacture, to secure a desirable white color a fine granulation of the salt produced.

The natural consequence of that course of operation is an aline reaction of the salt, — a most objectionable quality of airy salt, for it hastens on the decomposition of the ter.

The peculiar nature of the products of the dairy, — butter cheese, — as well as the unusual pecuniary risks involved heir successful manufacture, renders it necessary that y first-class articles of salt should be applied for dairy poses. The fitness of any of the various brands of salt ur markets for dairy use is not restricted to those obed from any particular natural source or locality, but deds entirely upon a suitable good chemical composition, a suitable mechanical condition.

A good dairy salt ought to be of a neutral reaction, and of ure saline taste; free from offensive odor, and without stain of color; of a properly reduced size to favor a edy solution; and, what is scarcely of less importance, from colored specks. As the application of dairy salt orm of saturated solutions enables, with but little trouble, removal of insoluble foreign admixtures, this mode of g salt in the dairy industries, whenever admissable, deres commendation.

To produce an article of the above description requires an a exertion on the part of the manufacturer, and necessis thus additional expenses, as compared with the average nds of "common fine" and the ordinary "coarse or

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solar salts," neither of which, as a general rule, the previous description.

A dairy salt, originally good, may become objec consequence of a subsequent careless storing ami smelling articles of merchandise, etc., or in barns

Judging the above samples of "dairy salt" b tomary commercial standard of composition prev plained, it will be noticed that sample I. is pre sample II., although its total amount of foreign sal ture is larger than in samples II. and III. The I sample would rank next, if it did not contain som acid.

None of the above three samples can claim to the better brands of "dairy salt" in our markets.

The presence of an exceptional amount of car lime in all of them impairs greatly their fitness purposes A good salt may not improve mate otherwise carelessly manufactured butter or chee lower grade of fine salt will invariably destroy the quality of a good butter and cheese.

The addition of salicylic acid as a preservative is condemned by good authorities in sanitary matters.

DAIRY SALT.

[Sent on from Amherst, Mass.]

Moisture at 100° C.,	
Sodium chloride,	
Calcium sulphate,	
Calcium chloride,	
Magnesium chloride,	
Insoluble matter (chiefly carbonate of magnesia and sand),	

ROCK SALT.

[From the Retsof Salt Mines at Piffo·d, Livingston County, New York from Springfield, Mass.]

Moisture at 100° C.,	
Calcium sulphate,	
Calcium chloride,	
Magnesium chloride,	
Sodium chloride,	
Insoluble matter,	

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This article has been, of late, introduced into our market lump form, to take the place of the English lump salt for ck feeding. The sample sent on for examination was of very fair quality, and compared very favorably with the mer. Its selling price at Springfield, Mass., is stated: m 5 to 10 pounds, at 1½ cents per pound; 100 pounds, at cents; wholesale, per ton of 2,000 pounds, at $8.50; and car-loads, one dollar less per ton.

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SALT.

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock Salt of Pettite Ause, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for Examination.
Rock Salt of Neyba, St. Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar Salt, Onondaga, N.Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar Salt, Hocking Valley, Ohio.	2.130	97.512	None.	.234	.089	–	–	–	
Solar Salt, Saginaw Valley, Mich.,	3.344	95 813	.316	.356	.140	–	–	–	
Solar Salt from Kansas,	4.950	93.060	1 220	–	.240	.350	.180	–	
Solar Salt, Lincoln County, Nebraska,	1.200	98.130	.250	–	.080	.390	None.	–	
Common Fine and Boiled Salt, Onondaga. N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common Fine and Boiled Salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common Fine and Boiled Salt, Mason City, Ohio,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and Table Salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga Dairy Salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine Salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine Salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049			.028	

FIELD EXPERIMENTS.

Field A. Fodder Corn Raised with Single Articles of Plant Food.

Field B Fodder Crops Raised with and without Complete re.

Field C. Experiments with Wheat, Vetch and Oats, Serradella uthern Cow Pea.

Field D. Experiments with Potatoes, Roots and Miscellaneous

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FIELD EXPERIMENTS

[Field A.]

1. FODDER CORN RAISED UPON UNDERDR PARTLY FERTILIZED WITH SINGLE ARTICI FOOD, PARTLY WITHOUT THE USE OF A MATTER.

The field utilized for this experiment cons joining plats, one-tenth of one acre each in si are five feet apart; the grounds between them from any growth, and receive no fertilizing any description.

The entire field is surrounded by a tile drai has a separate one through its centre. This its east end in a well which is connected with ing drain.

The land was used, for several years previo lishment of the Experiment Station, in 1882 for the production of hay. During the spr was planted with corn, for fodder corn, with any fertilizer.

The same course of planting and cultivati out during 1884, for the purpose of exhausti far as practicable, for a remunerative cultivati

The crop raised in 1884 upon these plats land left no doubt concerning their exhauste far as further successful cultivation of corn v for the entire yield of corn fodder amounted to with a moisture of thirty per cent.

This condition of the soil encouraged the special inquiry into the chemical and physic our soil, as far as *its relation to the producti crop is concerned*. With that end in view

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rse was decided upon and carried out during the succeed-
season (1885).

he entire field (A) was prepared, May 12, in a similar
ner as in preceding years for the planting of corn (see
ond Annual Report, page 81). All except Plat 6 were
ted with (Clark) corn.

No. 0, ...	Thrown out of the experiment.
No. 1, ...	Twenty-five pounds of sodium nitrate (= to 4 lbs. of nitrogen).
No. 2, ...	Nothing.
No. 3, ...	Thirty pounds of dried blood (= to 4 lbs. of nitrogen).
No. 4, ...	Nothing.
No. 5, ...	Twenty-five pounds of ammonium sulphate (= to 5 lbs. of nitrogen).
No. 6, ...	Nothing. (Black Fallow.)
No. 7, ...	Fifty pounds of dissolved bone-black (= to 85 lbs. of available phosphoric acid).
No. 8, ...	Nothing.
No. 9, ...	Twenty-five pounds of muriate of potash (= to from 12 to 13 lbs. of potassium oxide).
No. 10, ...	48½ pounds of potash-magnesia sulphate (= to from 12 to 13 lbs. of potassium oxide).

he growth on the entire field was cut Sept. 5, and the
luct of each plat stooked by itself in the field for drying;
as housed Oct. 10, with the following results:—

1885.

PLAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applied.
1, . .	480 lbs.	25 lbs. of sodium nitrate (= to 4 lbs. of nitrogen).
2, . .	310 "	Nothing.
3, . .	350 "	30 lbs. of dried blood (= to 4 lbs. of nitrogen).
4, . .	300 "	Nothing.
5, . .	360 "	25 lbs. of ammonium sulphate (= to 5 lbs. of nitrogen).
6, . .	–	Fallow.
7, . .	280 "	50 lbs. of dissolved bone-black (= to 8.5 lbs. of available phosphoric acid).
8, . .	250 "	Nothing.
9, . .	945 "	25 lbs. of muriate of potash (= to from 12 to 13 lbs. of potassium oxide).
10, . .	845 "	48½ lbs. of potash-magnesia sulphate (= to from 12 to 13 lbs. of potassium oxide).

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Comparing these results with those obtaine
vious year, where the products of the various pl
tically of a corresponding weight (458 lbs.
noticed that *the application of potash compoun*
riate of potash leading (see Plats No. 9 and 10
a marked effect on the *quantity* and the *quali*
fodder raised, increasing the previous annual
than one hundred per cent. above that of
year (1884).

The amount of corn fodder raised on Plat
received nitrate of soda, had exceeded but slig
that of the previous season; while the applica
ammonium sulphate and phosphoric acid, had
a considerable falling off. The yield of corn
tilized and unfertilized plats was practically
Plats 1 to 8.

In sight of these facts, it seemed but justifiab
that a *deficiency of the soil in available potash*
in our case, more than that of any other esse
plant food, the final yield of the crop.

As the cultivation of grasses and fodder co
manurial resources of the soil in a similar di
stracting approximately one part of phosphori
parts of potash, it is but a natural result that
originally did not contain much more of av
than of available phosphoric acid, must beco
tive before the latter is exhausted. In case
necessitate a direct succession of these two c
to remember that fact, and to provide agains
applying to the soil liberally, in particular,
pounds in some form or other. Muriate of p
recommendation.

To verify the above conclusion, the experin
tinued during the year 1886, with the *sol*
of increasing on each fertilized plat the part
ing ingredients to twice the amount used in
year.

The plats were thoroughly ploughed and h
15, 1886. The fertilizers were sown broadcas

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lightly harrowed in before planting the corn, in rows, 21 and 22 (Clark's variety). The rows were three three inches apart. The seeds were dropped from e to fourteen inches apart, and six to eight kernels in a . The mode of planting and the subsequent treatment e crop was in every way corresponding to the course ed in the two preceding years. The young plants ap- d uniform and healthy looking, in all plats, June 1. turned, however, to a pale green color by June 28, the exception of those on Plats 9 and 10. The latter still of a dark green color Sept. 11, when the entire was cut and stooked in the field. The corn growing ats 1 to 8, inclusive, had reached, at the end of the n, a height of from two to four feet, and showed only and there a partially filled ear; it was badly dried up nhealthy looking when cut. The plants grown upon 9 and 10 had reached a height of from five to eight the stalks and leaves were still succulent when cut, he ears pretty well formed throughout the plats, but , and the kernels scarcely beginning to glaze.

e weight of the corn fodder raised upon each plat was ained Oct. 23, when the crop was housed. The subse- statement contains the results of the experiment. veights of the corn fodder are stated with reference to me state of moisture (from 45 to 50 per cent.) as in receding year, to allow a comparison of the results.

1886.

LAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applied.
. . .	430 lbs.	50 lbs. of sodium nitrate (= to 7 to 8 lbs. of nitrogen).
. . .	250 "	Nothing.
. . .	310 "	60 lbs. of dried blood (= to 7 to 8 lbs. of nitrogen).
. . .	250 "	Nothing.

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1886.

PLAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applie
No. 5, . .	280 lbs.	50 lbs. of ammonium sul lbs. of nitrogen).
6, . .	–	Fallow.
7, . .	255 "	100 lbs. of dissolved bone lbs. available phosphor
8, . .	195 "	Nothing.
9, . .	840 "	50 lbs. of muriate of pota of potassium oxide).
10, . .	895 "	97 lbs. of potash-magnesi 25 lbs. of potassium ox

These results, compared with those of the p show still a falling off in yield in all plats, no a decided increase in the various single manuri applied on Plats 1, 3, 5, 7, 9 and 10. The yie tilized Plats 1, 3, 5 and 7 during 1886 was less the unfertilized plats in 1885. The good servi *compounds* as the *sole fertilizer was still as stri two preceding years.*

1887.

The examination into the condition of "Fie as its store of available plant food is concern tinued during the past year, with a view to sho sible, still more decidedly, that a serious exha soil in available potassa, in particular, was the of a reduced production of corn fodder. To end the following course has been pursued: —

The various plats were ploughed and harr the second week of May. Plats 2, 4 and 8, w vious years had been planted with corn withe any fertilizing ingredients, were used again fo of corn fodder, and left unfertilized as before. 5, 7, 9 and 10 were fertilized broadcast before corn. The mode of planting and the subseque of the crop was the same as in preceding ye which for several years in succession had receiv tilizer but from 4 to 8 pounds of nitrogen nitrate of soda, was fertilized with a mixture o

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nitrate of soda (= 7 to 8 pounds of nitrogen) and 50 unds of muriate of potash (= 25 pounds of potassium ide).

No. 3, for several years in succession fertilized with from to 8 pounds of nitrogen in form of dried blood, was ated with a mixture of 60 pounds of dried blood (=7 to pounds of nitrogen) and 100 pounds of dissolved bone-ck (= 16 to 17 pounds of available phosphoric acid).

No. 5, for several years in succession fertilized with 4 to pounds of nitrogen in form of sulphate of ammonia, re-ved as fertilizer a mixture of 50 pounds of ammonium phate (= 10 pounds of nitrogen) and 97 pounds of ash-magnesia sulphate (= 25 pounds of potassium oxide).

No. 7, for two succeeding years fertilized with from 8 to pounds of available phosphoric acid, was treated with a xture of 100 pounds of dissolved bone-black (= 16 to 17 unds available phosphoric acid) and 50 pounds of muriate potash (= 25 pounds potassium oxide).

No. 9 was fertilized, as in preceding years, with nothing muriate of potash, of which 50 pounds were applied 25 pounds potassium oxide), the same quantity pre-usly used (1886).

No. 10, in preceding years fertilized with from 12 to 25 unds of potassium oxide in form of potash-magnesia sul-te, received a mixture of 97 pounds of potash-magnesia phate (= 25 pounds potassium oxide) and 60 pounds of ed blood (= 7 to 8 pounds nitrogen).

The corn (Clark) was planted, in the same manner as in preceding years, May 23. The crop upon the entire d looked uniform and healthy until the middle of July. osequently a gradual change in appearance became notice-e. The growth upon the plats which had either received fertilizer, or one which did not contain potash, turned lowish, ceased to grow, and produced a few imperfect s; while, upon those plats which had been fertilized with aterial containing potash, it retained its healthy appear-e, reached its normal height and produced a liberal num-of perfect ears. The entire crop was cut and stooked in field Sept. 15; it was housed, after being weighed, . 17.

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The following tabular statement of our fie
three succeeding years needs scarcely any fur
tion. The beneficial influence of a potash s
yield of fodder, upon our experimental plats
instance unmistakable ; while the application
supply of phosphoric acid and nitrogen, either
combined, on the whole, does not materially
nual yield, when compared with the unfertilize

The investigation will be continued, with so
tions, to serve as an illustration concerning th
one-sided exhaustion of farm lands, and to assi
out some practical lessons for an economical m
the latter.

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Number of Plat.	Fertilizers Applied.			Yield of Dry Fodder Corn.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1, . . .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
Plat 2, . . .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
Plat 3, . . .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
Plat 4, . . .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
Plat 5, . . .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
Plat 6, . . .	Fallow, ...	Fallow, ...	Fallow, ...	–	–	–
Plat 7, . . .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	280	255	730
Plat 8, . . .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
Plat 9, . . .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
Plat 10, . . .	48½ lbs. of potash-magnesia sulphate (= to 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= to 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

Plat 0 was thrown out of the experiment.

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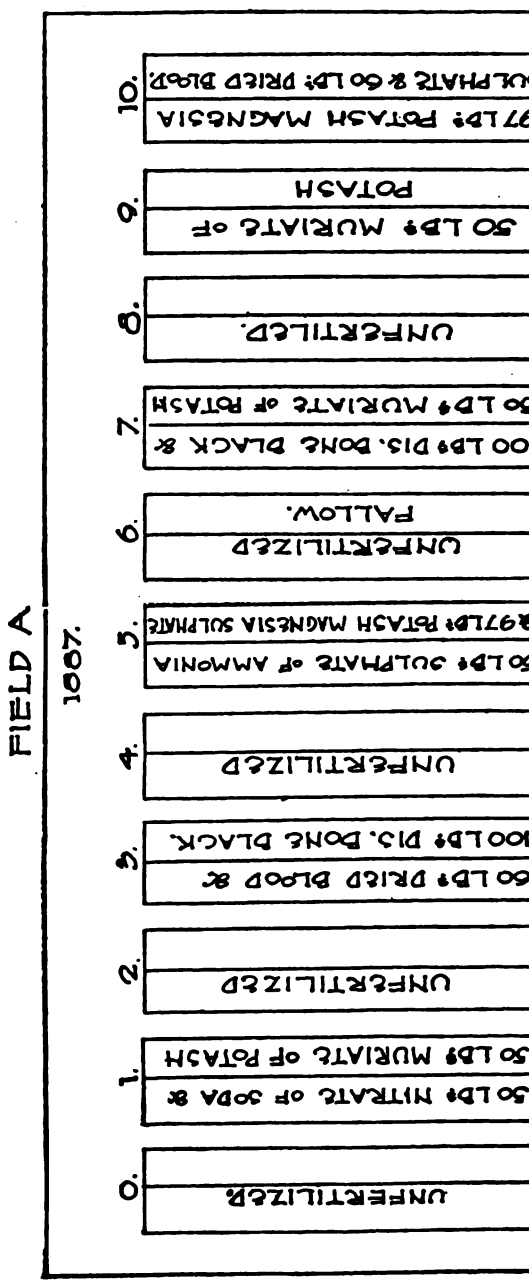

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Influence of Fertilizers on the Quantity and the Quality of some Prominent Fodder Crops.

(Field B.)

he land selected for the experiment had been used for ral years for the production of hay. At the beginning e season of 1883 it had been ploughed and planted with , *without the addition of any fertilizer*. The soil con- d of a good, sandy loam, and was, in consequence of its ious treatment, in a *suitably impoverished condition* to ond to the application of fertilizers.

he entire field, consisting at that time of one and one- h acres, was sub-divided into plats, each one-tenth of an in size. Every alternate plat was fertilized at the rate ix hundred pounds of ground, rendered bones, and two lred pounds of muriate of potash, per acre. The fertil- was applied a few days before seeding, and slightly har- ed under.

884.—The experiment in this year comprised four stand- grasses; i. e., Orchard grass (*Dactylis glomerata*), dow Fescue (*Festuca pratense*), Timothy (*Phleum ense*) and Redtop (*Agrostis vulgaris*), besides two Mil- Hungarian grass (*Panicum Germanicum*) and Pearl et (*Penicillaria spicata*), and one variety of corn, k.

ats No. 11, 13, 15, 19 and 21 were fertilized; and Nos. 14, 16, 18 and 20 received no manurial matter of any ription. In the case of the grasses and millets, each was again sub-divided into two, and each half seeded n with one distinct kind of grass seed, as follows: —

No. 11 (fertilized), . . .	Orchard Grass (north side). Meadow Fescue (south side).
No. 12 (unfertilized), . .	Orchard Grass (north side). Meadow Fescue (south side).
No. 13 (fertilized), . . .	Hungarian Grass (north side). Pearl Millet (south side).
No. 14 (unfertilized), . .	Hungarian Grass (north side). Pearl Millet (south side).
No. 15 (fertilized), . . .	Timothy (north side). Redtop (south side).

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Plat No. 16 (unfertilized), . . { Timothy (north si
Redtop (south sid

Plats No. 17, 18, 19, 20 and 21 were planted with corn (C

1885. — During the year 1885, Plats No. 17
and 21 served again, as in previous years, for th
of corn. The entire crop upon all plats was
1885. The dry corn fodder secured from the fe
averaged $5\frac{1}{6}$ tons per acre, and that from the
plats yielded $3\frac{1}{10}$ tons for the same area. Th
Plat No. 13 produced 1,870 pounds of drie
18,700 pounds ($9\frac{1}{3}$ tons) per acre; and the unfe
No. 14 (for three succeeding years without m
duced 1,050 pounds of air-dried crops, or 10,5
($5\frac{1}{4}$ tons) for a corresponding area.

The Plats 11, 12, 15 and 16 (Field B), which
seeded down broadcast during the month of
1884, with several varieties of grasses, for the
studying their individual nutritive character at di
cessive stages of growth, soon became infested wit
of plants. As this circumstance could not othe
quite seriously interfere with our object, it was th
to re-plough these plats, and *to seed down again e*
of grass, in drills. The cultivation of grasses in
feet apart, was adopted with much success, June
A frequent use of the cultivator, aided by the hoe
weeding, has enabled us to secure, as far as pra
clean growth.

1886. — No material change was made in the g
rangement and mode of treatment of the plats in
beyond the addition, on the west end of each p
area forty-three feet in length, and a width corresp
that of the existing plats. This addition makes th
length of these plats 175 feet; they are each 33 fe

The same varieties of grasses and of corn (Cla
cultivated. The latter was also planted, in place
varieties of millets, cultivated during the preceding
Plats 13 and 14. The corn was planted, as in
years, in drills three feet three inches apart; the s
dropped, from six to eight in a place, at a distance

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lve to fourteen inches apart, May 17, 1886. Plats 13, 19 and 21 were fertilized with ground bone and potash, n preceding years; while Plats 14, 18 and 20 received manurial matter of any description. The growth of the n on fertilized and unfertilized plats presented throughout season a similar appearance, as has been noticed and cribed on previous occasions, with the exception of the ilized Plat 13 and the unfertilized Plat 14, which yielded rger return than any other of the plats under a corre-nding treatment. These two plats had been changed n the cultivation of corn, in 1883, to that of millet, in 4 and 1885.

'or further details regarding yield, etc., we have to refer ages 71 and 72 of our fourth annual report.

'he entire field was ploughed during fall, to prepare it for eriments with other crops in the succeeding year. The ples of the various grasses on trial had been collected at cessive stages of growth, to ascertain their composition. results of these analyses are contained in the following ular statement.

ORCHARD GRASS (HAY).

	Collected June 7, 1886, while in Bloom.		Collected June 30, 1886, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
sture at 100° C.,	9.09	9.16	8.38	8.72
Matter,	90.91	90.84	91.62	91.28
	100.00	100.00	100.00	100.00
nalysis of Dry Matter.				
le Ash,	7.90	8.67	6.17	5.46
Cellulose,	34.12	34.15	35.48	35.79
Fat,	2.41	2.40	3.56	3.26
Protein (Nitrogenous Matter),	8.94	11.24	7.57	8.15
-nitrogenous Extract atter,	46.63	43.50	47.22	47.34
	100.00	100.00	100.00	100.00

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REDTOP (HAY).

	Collected July 5, 1886, while in Bloom.		Co
	Fertilized.	Unfertilized.	F
Moisture at 100° C.,	6.81	7.75	
Dry Matter,	93.19	92 25	
	100.00	100.00	
Analysis of Dry Matter.			
Crude Ash,	5.69	5.17	
" Cellulose,	34.11	32.95	
" Fat,	1.56	1.64	
" Protein (Nitrogenous Matter),	8.32	8.40	
Non-nitrogenous Extract Matter,	50.32	51.84	
	100.00	100 00	

MEADOW FESCUE (HAY).

	Col
	Fert
Moisture at 100° C.,	
Dry Matter,	
	1
Analysis of Dry Matter.	
Crude Ash,	
" Cellulose,	
" Fat,	
" Protein (Nitrogenous Matter),	
Non-nitrogenous Extract Matter,	
	1

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TIMOTHY (HERDS' GRASS).

	Collected June 28, 1886, while in Bloom.	
	Fertilized.	Unfertilized.
ture at 100° C.,	65.74	65.00
Matter,	34.26	35.00
	100.00	100.00
Analysis of Dry Matter.		
le Ash,	5.29	5.37
Cellulose,	33.23	32.50
Fat,	1.95	2.07
Protein (Nitrogenous Matter),	8.20	8.83
nitrogenous Extract Matter,	51.33	51.23
	100.00	100.00

Fertilizing Ingredients of Timothy.

	Fertilized.	Unfertilized.
ture at 100° C.,	7.80	7.24
phoric acid (6 cents per pound),	0.36	0.56
sium oxide (4½ cents per pound),	1.63	1.44
gen, (17 cents per pound),	1.21	1.31
m oxide,	0.08	0.37
um oxide,	0.44	0.99
esium oxide,	0.12	0.09
uble matter,	1.01	1.33
ation per 2,000 pounds.	$5 93	$6 35

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Fertilizing Ingredients of Orchard Gr

[I. Fertilized. Collected in bloom, June 7, 1886. II. Unferti
bloom, June 7, 1886. III. Fertilized. Collected in se
IV. Unfertilized. Collected in seed, June 30, 1886.]

	Pe	
	I.	II.
Moisture at 100° C.,	9.09	9.16
Phosphoric acid,	0.483	0.39
Potassium oxide,	2.339	2.11
Nitrogen,	1.300	1.64
Sodium oxide,	0.211	0.23
Calcium oxide,	0.401	0.45
Magnesium oxide,	0.255	0.23
Ferric oxide,	0.014	0.02
Insoluble matter,	1.867	1.97
Valuation per 2,000 pounds,	$6 99	$7 8

Fertilizing Ingredients of Redtop Ha

[I. Fertilized. Collected in bloom, July 5, 1886. II. Unferti
bloom, July 5, 1886. III. Fertilized. Collected in seed,
Unfertilized. Collected in seed, July 22, 1886.]

	Pe	
	I.	II.
Moisture at 100° C.,	6.81	7.75
Phosphoric acid,	0.377	0.39
Potassium oxide,	1.206	1.05
Nitrogen	1.240	1.24
Sodium oxide,	0.180	0.42
Calcium oxide,	0.614	0.64
Magnesium oxide,	0.125	0.14
Ferric oxide,	0.024	0.03
Insoluble matter,	1.716	1.68
Valuation per 2,000 pounds,	$5 53	$5 5

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Fertilizing Ingredients of Meadow Fescue.

Fertilized. Collected in seed, June 28, 1886. II. Unfertilized. Collected in seed, June 28, 1886.]

	Per Cent.	
	I.	II.
sture at 100° C.,	7.40	8.03
sphoric acid,	0.230	0.229
assium oxide,	1.815	2.183
rogen,	1.04	1.07
ium oxide,	0.080	0.139
cium oxide,	0.540	0 466
gnesium oxide,	0.140	0.136
ric oxide,	0.027	0.025
oluble matter,	1.403	1.961
uation per 2,000 pounds,	$5 36	$5 87

The higher percentage of *nitrogenous matter* in the crop m the *unfertilized* plats, over that from the *fertilized* ts, finds its explanation in the fact that, owing to the nty supply of plant-food in the former, the plants matured an earlier date. The advantages of fertilization are, refore, not shown in the percentage of nitrogenous matter, in an increased total yield of a healthy, vigorous growth.

1887. — The lands were ploughed and harrowed during second week of May. The original lines of sub-division re retained. Plats 12, 14, 16, 18 and 20 remained unfer-zed, as in previous years. Plats 11, 13, 15, 17, 19 and were fertilized, as before, with a mixture of 600 pounds fine-ground bones, and 200 pounds of muriate of potash, acre. The fertilizer was applied broadcast, and slightly rowed under before seeding. The different plats were nted May 18, and the seeds, in every case, laid in drills, m two feet to three feet three inches apart, as circum-nces advised, — grasses and clovers, two feet, and corn l peas, three feet three inches, apart.

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Plat No. 11 (fertilized), . .	Corn (Clark variety)
Plat No. 12 (unfertilized), .	Corn (Clark variety)
Plat No. 13 (fertilized), . .	Italian Rye Grass (L English Rye Grass (L
Plat No. 14 (unfertilized), . .	Italian Rye Grass (L English Rye Grass (
Plat No. 15 (fertilized), . .	5 varieties Southern
Plat No. 16 (unfertilized), . .	5 varieties Southern
Plat No. 17 (fertilized), . .	Meadow Fescue (*Fe*
Plat No. 18 (unfertilized), . .	Alsyke Clover. Medium Red Clover.
Plat No. 19 (fertilized), . .	Alsyke Clover. Medium Red Clover.
Plat No. 20 (unfertilized), . .	Mammoth Red Clove Alfalfa (Luzerne).
Plat No. 21 (fertilized), . .	Mammoth Red Clove Alfalfa (Luzerne).

The results regarding the yield of the ann
corn and cow peas — are stated below; while
the comparative yield of the perennial plants –
clovers — are reserved for another year. Th
these plants show their respective values as
better in the second year, when seeded somewl
spring. Our present communication is, for thi
fined to some analyses of the first cut of Alfalf
clover.

Plat 11 (fertilized) yielded 3,910 pounds of
corn; Plat 12 (unfertilized) yielded 2,890 po
fodder corn, — a difference of thirty per cent
the fertilized plat. The plant-food coming fr
tegration of the sod of the preceding grass crop
favored an increased production upon the unfe

Plats 15 and 16 were each planted May
different varieties of Southern peas, the seeds
secured of J. J. Wolfenden, provision dealer i
N. C.

1. Sugar Crowder.
2. Black (Pallack).
3. Whippoorwill Cow Pea.
4. Clay Cow
5. Crowder.

The entire lot grew slowly at first until the
warmer. The vines of No. 5 became diseased,
prematurely. Nos. 2, 3 and 4 produced

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wth, from 28 to 30 inches high. None but No. 2 pro-
ed, to any extent, matured pods.

The entire yield on Plat 15 (fertilized) amounted to 2,400
nds of green crop, containing from 18 to 19 per cent. of
vegetable matter.

Plat 16 (unfertilized) produced 1,300 pounds of green
der, — a difference of 54 per cent. in favor of the fertil-
l plat. An analysis of No. 4, Clay variety of Southern
pea (*Dolichos*) will be found in a later chapter, on new
der crops. The crop was cut for fodder, Aug. 29 to
t. 3.

ALFALFA (LUZERNE; HAY).

[Collected from Experiment Station Plats, Aug. 16, 1887, while in bloom. First Cut.]

	Fertilized.	Unfertilized.
sture at 100° C.,	8.33	8.41
Matter,	91.67	91.59
	100.00	100.00
Analysis of Dry Matter.		
de Ash,	7.18	7.83
Cellulose,	28.54	27.86
Fat,	1.54	2.04
Protein (Nitrogenous Matter),	11.12	12.96
n-nitrogenous Extract Matter,	51.62	49.31
	100.00	100.00

ALSYKE CLOVER (HAY; TRIFOLIUM HYBRIDUM).

[Collected from the Experiment Station Plats, Aug. 16, 1887, while in bloom.]

	Fertilized.	Unfertilized.
sture at 100° C.,	8.64	8.30
Matter,	91.36	91.70
	100.00	100.00
Analysis of Dry Matter.		
de Ash,	10.92	13.35
Cellulose,	26.28	21.44
Fat,	2.89	3.26
Protein (Nitrogenous Matter),	14.97	17.32
n-nitrogenous Extract Matter,	44.94	44.63
	100.00	100.00

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Fertilizing Ingredients of (1) Alfalfa, (2) Als

[I. Alfalfa. Fertilized. II. Alfalfa. Unfertilized. III. Alsyke
IV. Alsyke Clover. Unfertilized.

	Pe	
	I.	II.
Moisture at 100° C.,	8.33	8.41
Phosphoric acid,	0.444	0.45
Potassium oxide,	2.043	0.87
Nitrogen,	1.630	1.90
Sodium oxide,	0.668	1.35
Calcium oxide,	1.486	2.55
Magnesium oxide,	0.249	0.58
Ferric oxide,	0.105	0.08
Insoluble matter,	0.716	0.68
Valuation per 2,000 pounds,	$7 81	$7 6

The higher per cent. of nitrogenous matte
from the *unfertilized* plats, over that from the *f*
finds its explanation in the fact that, owing
supply of plant-food in the former, the plants
earlier date. The advantages of fertilization
not shown in the percentage of nitrogenous
an increase of total yield of a healthy, vigoro

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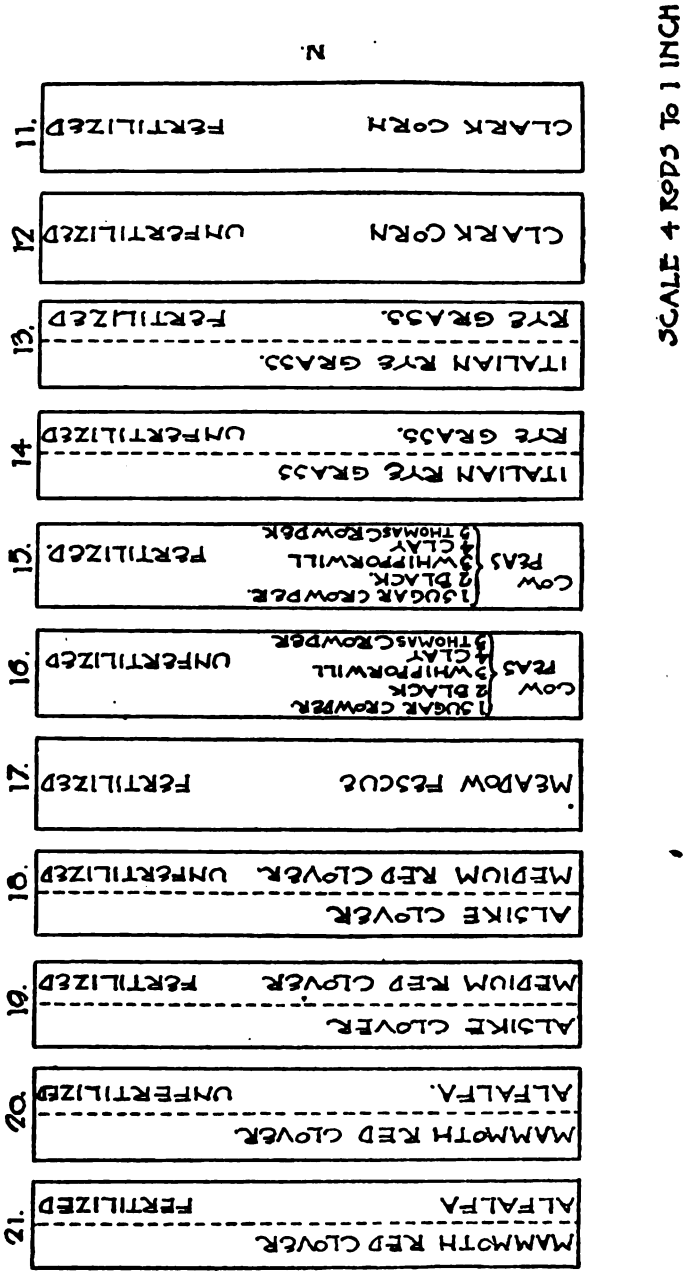

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3. Experiments with Wheat
(Fourteen Varieties.)

[Field C]

Fourteen varieties of winter wheat were
south half of Field C, in drills, eighty feet
three feet three inches apart, during the first
ber, 1886. The rows, eight in number, ran no

The soil consisted of a good loam; the f
were 600 pounds of ground bone, and 200 pou
of potash, per acre. Eight rows of the follo
varieties were sown: (1) Genoese, (2) E
Indian, (4) White Crimean, (5) Fulcaster,
(7) German Emperor, (8) Raub's Black
McGehee (white), (10) Diehl — Mediterranea
rowed Sheriff, (12) Martin's Amber, (13)
Oakley, (14) Amber (Mass.). The seed
thirteen varieties named was sent on by the
ment of Agriculture; that of the fourteenth
from Joseph Breck & Sons, Boston, Mass., fo
of comparing one of our reputed home variet
sent on.

The first four varieties (Genoese, Egyptia
White Crimean) were on the eastern portion
which was low and moist; they were entirely
and serradella was planted in their places. N
11 (Genoese and Four-rowed Sheriff) were
winter-killed, — so much so, that at time o
were left as worthless on the field. The Extr
ley (13) was the first variety to head, — th
On June 7 it was followed by number 14,
Amber Wheat. June 13, all save number 11
Sheriff) had headed. July 19, each variety
by itself, with the exception of Genoese (
rowed Sheriff (11), which were not far enou
and of poor growth. July 29, they were take
and threshed. Every variety was more or
by the rust.

The following table shows growth, height, c
of the eight rows of the different varieties tha

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VARIETY.	Growth.	Height in Inches.	Color.	Bearded or Unbearded.	Yield of the 8 Rows.			Remarks.
					Weight of Straw.	Weight of Grain.	Weight of Chaff.	
5. Fulcaster,	Compact, strong,	48	Light,	Bearded,	130	67	21	
7. German Emperor,	Compact, strong,	48	Light,	Bearded, Unbearded,	115	54	15	Evidently a mixture of two different varieties.
8. Raub's Black Prolific,	Not very compact,	36	Dark,	Bearded,	75	40	20	
9. McGehee (White),	Not very compact,	39	Dark,	Unbearded,	60	36	9	
10. Diehl — Mediterranean,	Compact,	39	Dark,	Bearded,	80	52	18	
12. Martin's Amber,	Compact,	42	Light,	Unbearded,	90	38	10	
13. Extra Early Oakley,	Not very compact,	33	Light,	Bearded,	60	36	9	
14. Amber (Mass.),	Compact,	39	Dark,	Bearded,	160	74	24	

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None of the imported varieties exceeded our
wheat in any essential point.

Vetch (Vicia sativa) *and Oats.* — An area of
tion over one-fifth of an acre was sown broad
with vetch and oat seed, — one part of vetch t
of oats.

The soil was prepared for the crop in the sa
the case of wheat.

On the 25th of May the young plants ap
ground. The first cutting was made July 8, t
standing three and one-half feet high, and the
in bloom; the cutting was stopped July 26.
pounds per day were cut, on the average, to
second feeding experiment with milch cows. I
by them much more than during the previou
the vetch was sown alone.

The yield of the area was fully two tons of
which would give an estimated yield of 10.89 t
fodder per acre.

Composition of Green Vetch and Oats.

	July 7.	July 20.	Ju
Moisture at 100° C., . . .	86.11	73.66	7
Dry Matter, ...	13.89	23.34	2
	100.00	100.00	1

The feeding ceased when the oats turned yell

Analysis of Green Vetch and Oats.

[Collected from Experiment Station Field, July 8, 1

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), . . .
Non-nitrogenous Extract Matter, ...

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e vetch has already received considerable attention in us sections of our country; reports, thus far, speak much satisfaction of the results. The plant resembles, ny respects, the common garden pea; there are early ate varieties in cultivation. Its period of vegetation is 18 to 22 weeks, and the time of seeding corresponds at of the pea. The common vetch is a hardier plant the latter, and grows well upon an inferior soil. Its ation as a valuable green fodder, either single or when n in common with rye, oats or barley, is well established. equal number of both plants gives a richer green r than the proportion we tried.

rradella (Ornithopus sativus, Brot.). — The area occu- by this plant was 206 feet long by 80 feet wide, and ged to a piece of land prepared in common with that for the cultivation of the varieties of wheat.

e seed was sown in drills, three feet three inches apart, 25. The plants began to bloom July 12. The cutting e crop for green fodder commenced Sept. 2; from 200 00 pounds were used per day, as part of the feed for cows. The supply lasted until Sept. 26. The yield r field amounted to 7,300 pounds of green fodder, or ns per acre, with an average of from 18 to 20 per of dry vegetable matter.

e serradella, like the vetch, is an annual leguminous , which found its way from Portugal into Central pe some fifty years ago. It grows from one to one and alf feet high, and prefers a moist, deep, sandy soil. of seeding and mode of cultivation correspond with customary in the cultivation of peas. The growth of lant is slow until the time of blooming, when it rapidly ases in size and nutritive constituents.

e close of the blooming period, at the end of August or ning of September, is with us the best time for cutting rop. Leading agriculturists speak very highly of this r plant.

r results in the field and in our feeding experiments "Feeding Experiment with Milch Cows, II.," in this t) have been for several years very satisfactory. The relish the serradella highly.

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Analysis of Green Serradella.

[Collected from the Experiment Station Fields, Sept.

Moisture at 100° C., ...
Dry Matter, ...

Analysis of Dry Matter.

Crude Ash, ...
" Cellulose, ...
" Fat, ...
" Protein (Nitrogenous Matter), ...
Non-nitrogenous Extract Matter, ...

Southern Cow Pea (Dolichos?); variety, valuable variety of Southern cow pea has b several years past, with very satisfactory res grounds of the Experiment Station. Its exce value for green manuring and for renovating been pointed out in previous annual reports. past summer season we have studied its com as green fodder for milch cows. The results periments are stated in this report under the he ing Experiments with Milch Cows, II." Th much liked by cows and horses, and its effect part of the daily diet for milch cows is very judging from our own results.

The fact that the seeds of the Clay or Whipp ties cannot be matured in our section of the co be considered a serious impediment to its more for the seeds may be had in unlimited quanti reasonable cost. J. J. Wolfenden, provisi Newberne, N. C , among others, has offered h the purchase of genuine seeds, at reasonable t

The ground which served during the past su for the cultivation of Southern cow pea for fee that used for the raising of serradella and of soil was prepared, as far as ploughing and fe concerned, in the same manner as that upon was raised. The seeds were planted May 25, feet three inches apart. The entire area occ

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in this part of our experimental field, was 101.5 feet and 80 feet wide; it yielded 3,765 pounds of green fod- with an average of from 12 to 18 per cent. of dry vege- matter. The rate of production per acre, calculated e basis of our own observation, would be 9½ tons of fodder. A few weeks more of growth would have rially increased the yield. The course adopted in our ng experiment obliged us to use the Southern cow pea, e serradella was not yet far enough advanced in growth. hern observers obtain from 20 to 25 tons of green crop cre. The cutting of the pea vines for fodder began as as Aug. 1, and lasted until Aug. 23. A new growth tarted from the roots again Aug. 25; it proved, how- of but little value for feeding purposes, on account of teness of the season.

Analysis of Southern Cow Pea.

[Collected from Experiment Station Fields, Sept. 2, 1887.]

	Per cent.
re at 100° C.,	78.81
atter,	21.19
	100.00

Analysis of Dry Matter.

Ash,	5.97
Cellulose,	23.02
Fat,	1.81
Protein,	8.28
itrogenous Extract Matter,	61.92
	100.00

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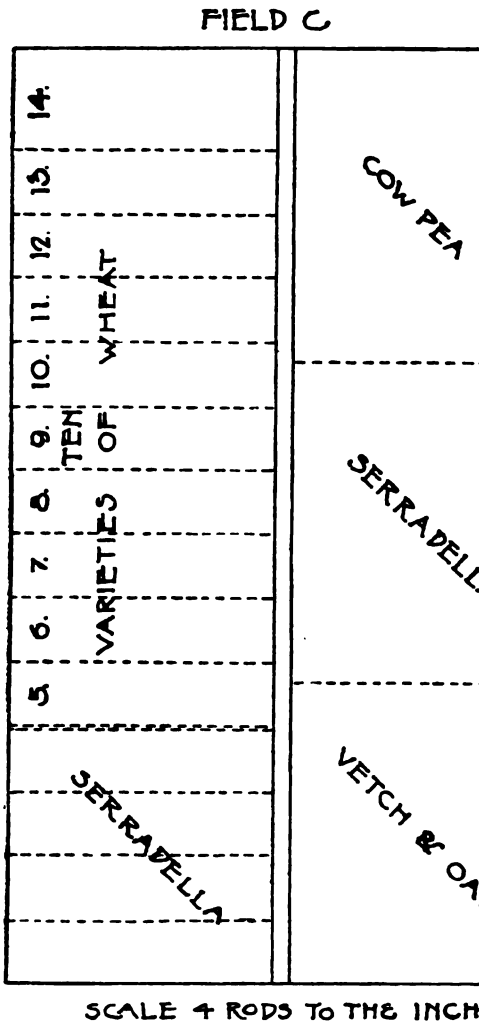

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4. Experiments with Potatoes.

(Var.: Beauty of Hebron.)

[Field D.]

— Experiments with High-grade German Potash Salts and Ground Bones, as Fertilizers.

he experiments were originally instituted (1884) for the ose of studying the effects of muriate of potash and hate of potash on the yield of potatoes, as far as quantity quality are concerned.

ree plats, each one-fifth of an acre in size, were chosen he experiment. The land had been for several years in s, and contained quite a number of old apple-trees. The rity of the latter were removed, and the turf thoroughly en up before manuring.

at 1 (west end) received 120 pounds of ground ren- d bones, and 30 pounds of muriate of potash (equal om 26 to 27 pounds of phosphoric acid, 4 to 4½ pounds trogen, and 15 to 16 pounds of potassium oxide).

at 2 received no manure.

at 3 (east end) received 120 pounds of ground rendered s, and 58 pounds of double sulphate of potash and nesia (equal to from 26 to 27 pounds of phosphoric 4 to 4½ pounds of nitrogen, 15 to 16 pounds of potas- oxide, and 5 to 6 pounds of magnesium oxide).

e fertilizers were applied broadcast, and harrowed under re planting. The potatoes were planted in rows three apart, and fourteen inches distant in the rows, during irst week in May, 1884. The crop was kept clean from ls by a timely use of the cultivator.

an additional feature of the experiment, one-half of plant was planted with medium-sized whole potatoes, other with half potatoes obtained from similar sized rs.

e crop obtained from Plats 2 and 3 were seriously dis- ed by scab, while that from Plat 1 had suffered less.

885. — The arrangement of the field, the mode of ma- g, and the variety of potatoes raised, were the same as

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in the preceding season. The seed potatoes
carefully selected from our own crop, raised
ceding season, on the same plats.

The young crop was hoed June 9. The di
plats was quite marked July 24: Plat No. 1,
muriate of potash, had the largest foliage and
green than the remainder; No. 3, fertilized w
potash, looked next best. A *blight on th*
showed itself during the first week of Augus
terminated the experiment; the vines upon
soon after. The crop was harvested Aug. 26.
from all the plats suffered severely from scab.

The exceptionally large proportion of smal
tained, in particular, from Plats No. 2 and 3,
low percentage of solids in the potatoes teste
premature termination of a healthful conditio
crop. The normal growth of the tubers cam
a standstill soon after the first examination
been made (July 24). The results seemed
connection between "blight" and "scab," a
any doubt about the circumstance, that either
other, or both jointly, had contributed directl
towards the partial failure of the crop for th
ing seasons.

It was decided, in sight of these facts, to c
periments in 1886 upon the same field, with s
tions, to ascertain, if possible, whether the
regarding the results in our past observat
ascribed to atmospheric agencies, or to the co
soil and the fertilizer applied, or to the quali
potato used.

1886. — The same field was used as in 18
was well prepared by ploughing and harrow
and subsequently fertilized, the same as in p
The change regarding the character of the fer
consisted in using nearly twice the amount o
muriate and sulphate of potash, for the same
Plats 1 and 3. A second important change
vious practice consisted in securing first qua
toes, — in particular, *free* from scab The s

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uty of Hebron — was obtained for that purpose from rmont; it was as fair an article as could be desired. The tem of planting and cultivating was the same as in preus years. The potatoes were planted upon all plats May 1886. All the vines were in full blossom July 6; they an to turn yellowish and dry up July 30. The crop on entire field was dried up Aug. 8. This change seemed appear most marked, and first, on the vines raised from ole potatoes. The crop was harvested Aug. 28.

Neither a liberal use of our own mixture of commercial nurial substances, rich in potash compounds, nor the selec- of a fair quality of seed potatoes from another locality, l affected our results, as compared with those of the preus season; for the entire crop, with scarcely any exception, badly disfigured by scab. The potatoes were unfit for ily use, and had to be sold at a low price for stock-feeding. For further details in regard to our observations in 1884, 5 and 1886, see annual reports.

A due consideration of all the circumstances which acnpanied our course of observation thus far, induced us to w the following conclusions: —

. Medium-sized *whole potatoes* give better results than f potatoes obtained from tubers of a corresponding size.

. Disregarding the results of the first year, when preusly existing resources of plant food in liberal quantities st have rendered the influences of an additional supply of nurial substances less marked, it appears that *sulphate of ash* produced *better* results in our case than muriate of ash.

. The *premature dying out of the vines*, accompanied by *ght* or *scab*, or both, must be considered a *controlling se* of the *exceptionally large proportion of small potatoes.*

. Some peculiar condition of the soil upon the lands d for this experiment is to be considered the real seat of trouble.

To test the correctness of conclusion 4 still further, the periment has been continued for another year.

1887. — The same plats as in previous years were utilized the experiment. The subdivision remained unchanged. e fertilizers applied were the same as in 1886.

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The lands were ploughed and harrowed c
week of May, and the potatoes planted in all
11. First quality potatoes, "Beauty of Hel
Vermont, were used as seed. The growth lo
all the plats until July 28, when the vines c
3 began to turn yellow. They commenced c
9, and by Aug. 12 were dry on all plats. A
of the little potatoes, July 1, showed already
the marks of scab.

The *entire crop*, when harvested, *was so se*
by scab that it proved worthless in the gener

The months of July and August were ex
and warm in our part of the State, — a circu
has, most likely, aggravated our trouble. Th
this year has been extensively a failure, i
wherever low lands have been used for its cul

B. — *Observations with Scabby Pot*

These experiments were inaugurated in 18
pose of inquiring into the circumstances wh
development and the propagation of the scab

1886. — The first year's work in this conn
confined to the task of observing the beha
potatoes as *seed* potatoes, under some de
treatment. To prevent a possible propagat
the new crop by infected seed potatoes, the fo
was adopted: Thoroughly scabby potatoes,
the previously described experimental plats
with some substances known to be destruct
forms of parasitic growth. This operation w
with the intention of destroying the propag
adherent germs of an objectionable character
ing the seed.

The field for the observation was distinctly
other experimental plats for the cultivation o
had been used for many years previous for
grass, and had since been planted but once, —
year (1885), with corn. The land was prepa
ing and harrowing in the same way as other

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was fertilized broadcast, at the rate of 600 pounds of ound rendered bones and 290 pounds of potash magnesia phate.

The field was subdivided into five plats of equal size, hty feet long and fifty feet wide, and the potatoes subse- ently planted in rows, three feet three inches apart, with ls three feet from each other in the rows. Three feet of ace was left between the plats unoccupied. The scabby d potatoes selected for the trial were, as far as practicable, a uniformly medium size. Each lot was immersed in the ticular solution prepared for the different plats; after ng kept there for twenty-four hours they were removed l directly planted.

Plat 1 was planted with *healthy* and *smooth potatoes*, with- any previous treatment. This course was adopted to rn whether soil, fertilizer, or atmospheric agencies of the son would favor the appearance of the scab in the crop.

Plat 2. The scabby seed potatoes were allowed to remain twenty-four hours in a saturated solution of muriate of ash before being planted.

Plat 3. A strong solution of hypochlorite of lime eaching lime) was applied in a similar way, for the prep- tion of the scabby seed, as in the case of Plat 2.

Plat 4. A saturated solution of carbolic acid in water, ved, in this instance, for the treatment of the scabby atoes.

The potatoes were planted in all plats on the same day, y 7. The vines did not appear evenly, at first; they re, however, equally vigorous upon all plats at the close June.

The tops on all plats were pretty generally dried up g. 18. The potatoes were harvested on the entire field g. 30. The yield on all the plats was fair, and the lity of the potatoes, almost without exception, excel- ; this seemed to be more striking in regard to those on ts 2, 3 and 4, which had been, in the beginning of the son, somewhat behind in growth. Here and there could seen a potato with a small mark of scab; a large propor- were perfectly smooth and without any sign of it.

The results were recorded as those of a first experiment.

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The fact that a *scabby potato* may produce, circumstances, a smooth and otherwise excell confirmed. Good potatoes have been raise seed potatoes suffering from scab, without treatment similar to ours. Without any inte pating the results of future observations, o with certainty the exact cause of our results. the opinion that a *difference in the conditio our old and new experimental potato plats* mig to be the principal cause of our trouble: yielded, from healthy potatoes, most inferio toes; whilst the latter produced, from scab most superior, smooth potato, under otherwis cal conditions, as far as soil, mode of cultiv of fertilizer were concerned, upon land in cl during the same season.

1887. — The experiment has been repea past season upon the same lands, with but a s tion. The soil was ploughed and fertilized as ing year. Ten plats, each fifty feet long, we four rows of potatoes, three feet three inches nineteen hills in the row. Medium-sized, potatoes (Beauty of Hebron), selected from upon our own fields during the previous year, described in some preceding pages, unde "Potato Experiment," "A," served as seed p half the plats were planted with scabby pot the same lot, after being immersed for eig some solution prepared for that purpose; and were planted without any previous treatment Plats 2, 6 and 10 with our scabby potato Hebron, and Plats 4 and 8 with healthy, smo the same variety.

Plat 1, ...	Scabby potatoes, soaked potassium sulphide
Plat 2, ...	Scabby potatoes, without treatment.
Plat 3, ...	Scabby potatoes, treated w hypochlorite of lime (b
Plat 4, ...	Smooth, healthy potatoes, treatment.

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at 5, ...	Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
at 6, ...	Scabby potatoes, without previous treatment.
at 7, ...	Scabby potatoes, treated with a solution of carbolic acid.
at 8, ...	Smooth, healthy potatoes, not treated.
at 9, ...	Scabby potatoes, treated with copper sulphate (blue copperas).
at 10, ...	Scabby potatoes, not treated.

The young plants made their appearance on all the plats, cept No. 9, June 1; those on No. 9 appeared eight or ten ys later. The entire crop looked uniformly well. The nes dried up on all plats at about the same time. The op was harvested with the following results: —

BEAUTY OF HEBRON.

AT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results. (Sept. 12, 1887.)
1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
2,		Scabby.	None.	Good; not scabby.
3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
4,		Good.	None.	Somewhat scabby.
5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
6,		Scabby.	None.	Good; not scabby.
7,		Scabby.	Carbolic acid.	Especially good.
8,		Good.	None.	Especially good.
9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results seems to show at a certain condition of the soil has been the leading use for the origin and propagation of the scab; for scabby ed potatoes have produced healthy, smooth tubers, both th and without any special previous treatment, — see ats 1, 2, 7 and 8. On the other hand, it is not without erest to notice that Plats 1, 3 and 7 have furnished us th some of the best potatoes we have raised during the st season.

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The investigation will be continued, with s
tions, another year.

P. S. — One of the best results with the
various kinds of potatoes during the past seas
with some seed potatoes sent on by the Unit
partment of Agriculture, called "Polaris,"
being imported directly from Ireland.

Roots. — The seeds used in this trial were
United States Department of Agriculture, w
tion of No. 7, Saxony sugar beet, which wa
our own collection of seeds. The supply of se

The land consisted of a good loam in a fai
fertilization. It had been manured for sever
annually, with a mixture consisting of 600 p
ground bone, and 200 pounds of muriate c
acre. The seeds, ten varieties in all, were
Each variety occupied two rows across the
length (80 feet).

No. 1, ...	Beet, Mangel Wurzel, "Gia
2, ...	Beet, Mangel Wurzel, "Yel
3, ...	Beet, "Eclipse."
4, ...	Beet, "Red Globe."
5, ...	Beet, "Egyptian Turnip."
6, ...	Beet, "Long Smooth Red."
7, ...	Beet, Sugar Beet, "Saxony."
8, ...	Turnip, Ruta Baga, "White
9, ...	Turnip, "Early Yellow" or
10, ...	Turnip, Ruta Baga, "Skirvin

The rows were three feet three inches apart
plants were, in every case, thinned out or tr
circumstances advised, to about eight inches
each other in the rows.

The transplanting and thinning out took
July 5 and 11; the weather during this time
for transplanting. The seeds of Nos. 6 and 9
as good as the others; the young plants of N
particular, did not do as well after transplant
mainder.

The crop was harvested partly Oct. 31 an
2. The first lot of roots, Nos. 1, 2, 3, 4 and
removed from the ground, was topped at o

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each kind were taken to the laboratory for a chemical ex-
nation; three of an approximately corresponding size
e photographed.

The second lot, Nos. 6, 7, 8, 9 and 10, was treated in a
ilar manner. The three sample roots selected in each
e, represent, as far as practicable, the smallest, medium
largest of each variety raised.

The photographs were taken with all the roots at an equal
ance from the camera.

STATEMENT OF RESULTS.

NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples Photographed.
			lbs.	lbs.
angel Wurzel, "Giant Long Red,"	2	150	365	11.75
angel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
eet, "Eclipse,"	2	163	285	4.
eet, "Red Globe,"	2	173	335	7.5
eet, "Egyptian Turnip,".	2	146	170	8.75
eet, "Long Smooth Red,"	2	145	185	5.
gar Beet, "Saxony,"	3	216	470	8.75
ta Baga, "White Sweet German,"	2	176	445	4.
rnip, "Early Yellow" or "Golden Stone,"	2	43	50	5.5
ta Baga, "Skirving's Purple Top,"	2	140	295	12.75

he analyses of the different varieties of roots will be
rted as soon as finished.

ISCELLANEOUS FIELD EXPERIMENTS WITH FARM AND GARDEN CROPS.

he field notes under the above heading are made for no
r purpose than to enter on record a series of experi-
ts, for various reasons, not yet fit for a general report.
some instances the supply of seeds was too small to
tle us to draw any particular conclusion; in others, the
ctions of seeds were made merely for the purpose of
paring the lands for a future special field experiment.

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The small supply of seeds was furnished, in the cases, by the U. S. Department of Agriculture.

The work carried on in this connection h obvious reasons, no other aim than to study t tion of some new field crop to our climate, pare some new variety of a prominent garden those frequently raised in our section of the field set aside for these experiments was in a go cultivation. Barnyard manure, supplemented b cial phosphates and potash compounds, had been past as manure; no alteration was made in this r ing the past season.

The list of seeds sown embraces, aside from th mentioned in previous pages, one variety o "Southern Giant Curled;" three of pepper, "Sweet Mountain," and "Golden Dawn;" two "Paragon" and "Improved Mayflower;" one "Early Summer;" two of cauliflower, "Early and "Giant Cauliflower," "Pyrethrum roseum variety of potato, "Polaris," in the form of see potatoes (two tubers).

The seeds were, in every instance, sown in a b subsequently transplanted in the field. All ma with the exception of *Pyrethrum roseum*, which nial plant.

Aside from these plants, there have also been on a small scale, Asiatic Rhubarb, Sago Bean (*Sag* wild potato from Colorado, and several reputed n of potatoes, to secure material for future experim

The recently ploughed old grass lands, on the the highway, were planted with potatoes, corn beans, squashes, several varieties of oats, and b lower portion, from five to six acres, has been during the fall into a permanent meadow; wh mainder of worn-out grass land in that locality to eight acres — has been underdrained and p the close of the season.

The details of the past year's work upon this land of the Station will be related hereafter, in with a description of a more matured system of

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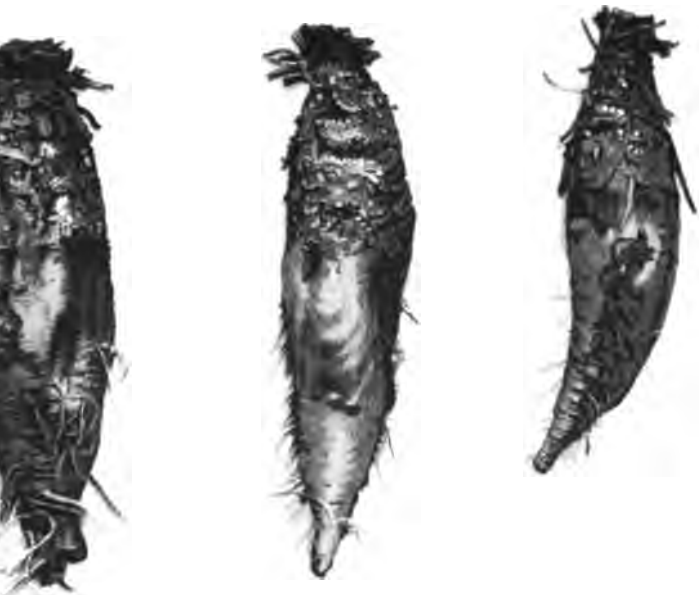
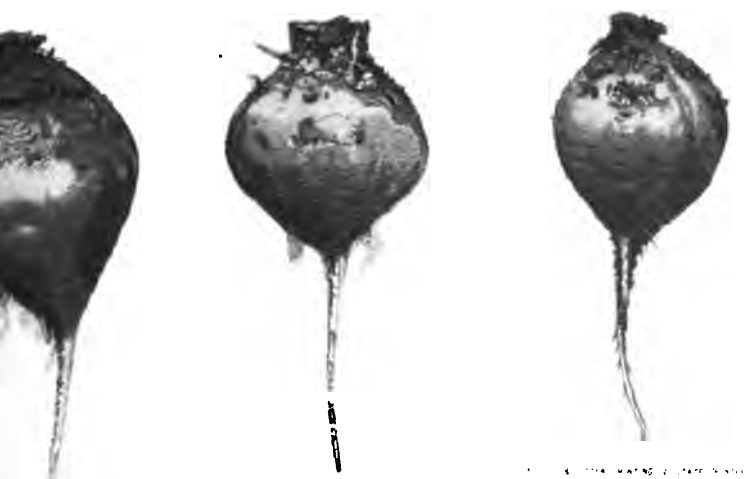


No. 1. Beet, Mangel Wurzel, "Giant Long Red".



No. 2 Beet, Mangel Wurzel, "Yellow Ovoid"

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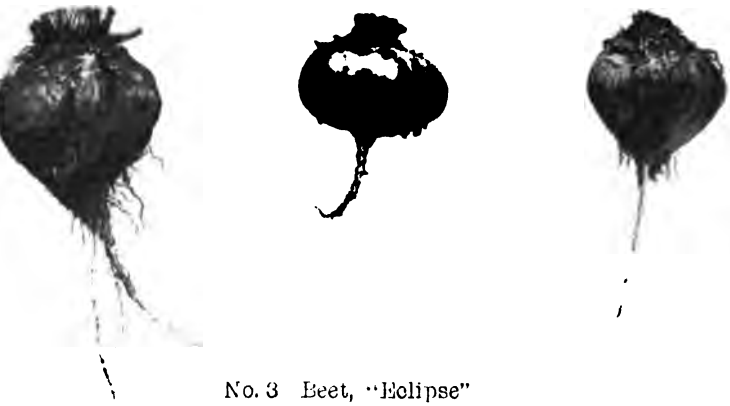
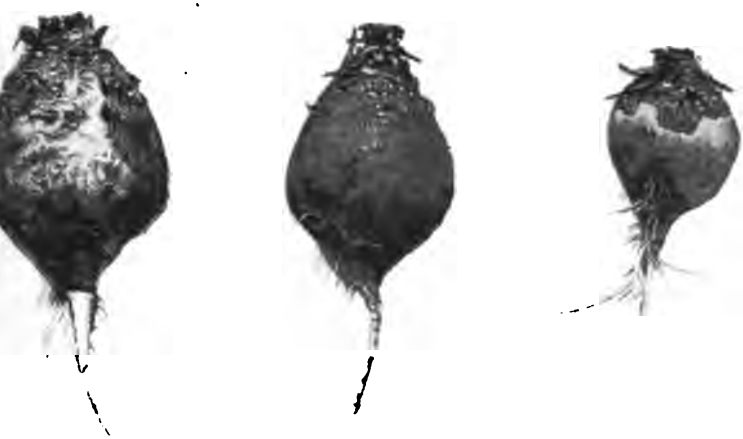


No. 3 Beet, "Eclipse"



No. 4 Beet, "Red Globe

No. 5. Beet, "Egyptian Turnip"

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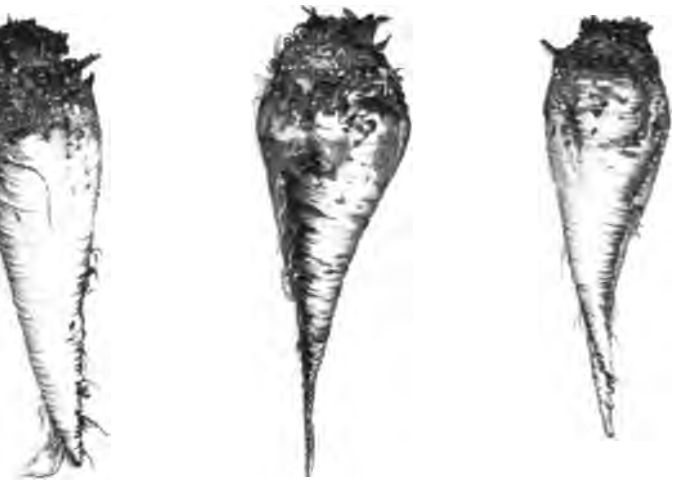
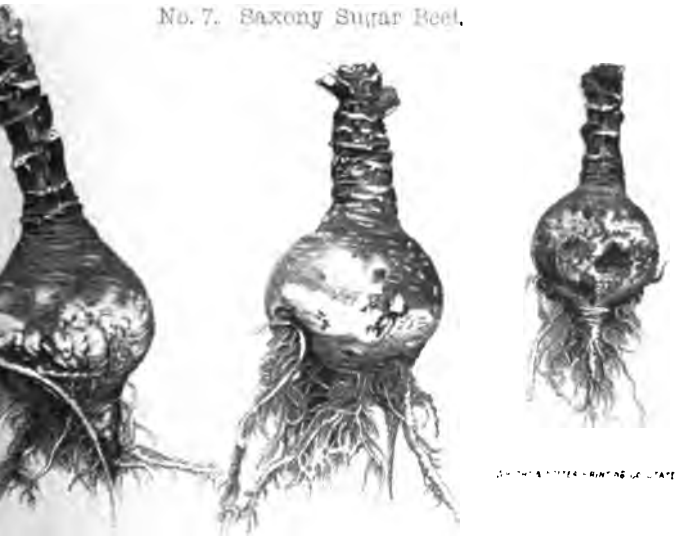
No. 6. Beet. "Long Smooth Red".



No. 7. Saxony Sugar Beet.



No. 8 Turnip, Ruta Baga, "White Sweet German".

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No. 9. Turnip. "Early Yellow" or "Golden Stone."

WRIGHT & POTTER PRINTING CO. STATE PRINTERS.

No. 10. Turnip. Ruta Baga, "Skirvings Purple Top".

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GGESTIONS UPON PLANTING TREES AND SMALL FRUITS.

[By S. T. MAYNARD, Professor of Botany and Horticulture, Massachusetts Agricultural College.]

The most important points to be considered in successful nting of trees and small fruits are: —

1. Selection of trees and plants.
2. Preparation of the trees and plants.
3. Soil and its preparation.
4. Methods of planting.
5. After-care and cultivation.

Selection of Trees and Planting.

Successful planting depends very largely upon the condi- n of the trees or plants at the time of planting The st results are generally obtained, *other things being equal*, en the trees or plants are obtained from local nurseries, l planted with little or no exposure to the drying influence the sun and air. The merits of the Massachusetts-grown es, as compared with those grown in the extensive nurse- s of distant States, are often discussed, and the latter ndemned for New England planting. While, in many of above-mentioned nurseries, owing to long experience, ecial skill and a soil naturally suited to the best growth, ry fine trees are grown, perhaps better than are generally wn in small local nurseries, yet the danger from injury in nsporting, should they go a great distance, and the length time from digging to transplanting, will make it gener- y safer to depend upon home-grown trees where they can obtained.

Great care must be exercised in digging, and, if large ntities are to be dug at once, as soon as a few are dug roots should be protected by mats or blankets, or have l thrown over them until all are to be packed for trans- rting or taken to the field for planting. In packing for pping, no material is so good to keep the roots moist and event their heating as clean sphagnum moss; for short tances, moist straw or hay may answer very well for this rpose.

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Vigorous young plants are much better t
have been a very long time in growing to suit
average age for fruit trees and plants in the
for transplanting is about as follows: Appl
from bud; pear, 3 years from bud; peach, 1
plum, 2 years from bud; cherry, 2 years fron
3 years from cutting or root graft; grape, 1
2 years No. 2, from cuttings or layers; cu
from cuttings; gooseberries, 2 years from
berries and blackberries, 1 year from sucker
tings; strawberries, only new runners of
growth should be used, the old plants havi
with the feeding surfaces so far from the cro
they are dug nearly all of them are destroyed

Preparation of Trees and Plants for

It is impossible to remove a tree from the
orchard without injuring some of the large
nearly all the rootlets and all the root hairs wi
by only a slight exposure to the air. As the
ing roots on the newly transplanted trees unti
formed, if none of the buds or shoots are
supply of moisture being insufficient, all mak
growth, or fail to develop at all, especially
comes on early in the summer. To prevent t
ensure a vigorous starting of a few buds, the
cut back in proportion to the amount of injur
which will generally be from one-half to tw
entire top. In this pruning all shoots should
away that are not needed for the formation of
and the others cut back one-half or two-t
length.

If the head is not formed high enough upon
may often be carried higher by cutting off all
leaving the most central one for a leader, upo
formed the new head, several inches higher
This may be still carried up by pinching the e
est laterals, to force the growth into the highe
in a single season, the head may be carried fr
feet higher than it was when received from the

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ured roots should have the ends cut smooth with a sharp fe; and with small fruits, like the grape, currant and awberry, it is often desirable to cut back some of the ger ones.

Soil and its Preparation.

Unless suitable soil is selected, very poor results will often obtained. The apple thrives upon a greater variety of ls than any other fruit, but that best suited to its growth rich, moist, well-drained loam. The pear, plum and nce require a heavier soil, but it should be free from stand- water. The cherry delights in a light, sandy loam. e peach can only be successfully grown in New England on high and well-drained land. Upon the tops of our h hills the trees are hardier, live longer and bear more it, although, even here, they are not safe from injury, l annual crops cannot be expected until some method of tection has been discovered that can be easily and cheaply plied. Grape vines give the best fruit in quality when nted upon high, gravelly soil; but, to insure a vigorous wth of vine to enable a large crop of fruit to mature, ne nitrogenous manure must be used, but only early in season, as a late application would induce a late growth wood, that is very liable to injury by severe cold.

The raspberry and blackberry mature their wood much ter upon light land than upon heavy, moist soil, but, like grape, require an addition of nitrogenous manure to ure a growth of canes sufficient to mature a large crop of t. Spreading mulch upon the surface, or constant culti- ion, will generally prevent the escape of moisture at the e of the ripening of the fruit, when it is most needed.

The currant and gooseberry require a moist, heavy soil for best results, but are liable to be thrown out by frosts if soil is not well underdrained.

The best soil for the strawberry is a moist, sandy loam. on light, sandy soils there is a tendency to a large num- of berries, but, there not being moisture enough in the , very few will mature.

Before planting it is necessary that the soil be made rich ugh to ensure a good growth, if it is not already in that

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condition. For small fruits it is generally b
manure or fertilizers broadcast and harrow in
be done for the large fruits, if the land is t
with some other crop for a few years.

If the trees are to be planted in land no
other crops, the manure or fertilizer would b
ically applied only about the trees, increasin
ered as they increase in size. Unfermented
never be placed in contact with the roots
plant, but if decomposed and well mixed w
injury will result from the use of a limited
best way to use coarse manure is to apply it
about the trees slightly covered with soil.
be used must be varied with the condition
should be used sparingly upon the peach u
bearing.

Perhaps the best material to use, where
sufficiently rich for the production of fruit
bone and potash, four parts of the former
muriate of potash. This, at the rate of o
tree, mixed in the fine soil used around the
pound applied near the surface, will insure
unless the soil is unusually poor. The holes
a little larger than the roots will extend, and
deeper than they are to be planted. For c
beauty, trees should be set at regular distanc

Methods of Planting.

Generally the best time for planting is in t
although it may be successfully done in the
leaves drop early and the shoots mature by

In the spring, trees should not be planted
will work up fine, and not compact when pr
roots. If the soil is light, the roots shoul
little deeper than they grew in the nursery,
same depth as they stood in the nursery is su
vines should be planted with the crown, o
a few inches of the surface, and the roots e
ten inches deep, according to the soil. Ra
berry and strawberry plants should be plan

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spring as the land will work. Black-cap raspberries t be planted with the large central bud near the surface, leep covering often destroys it; the roots, however, t be put, obliquely, as deep as they will go. It is im-tant that the soil be pressed *very finely* about the roots re all is filled in, and that upon the surface be left light. often happens that trees are received from the nursery dry, shrivelled condition, which, if planted in that state, ld certainly fail to grow. They may be improved, and ctimes saved, by burying top and root in moist soil for w days or a week; then, by severe pruning at planting, will be much more certain to grow.

After Care.

often happens that trees received in good condition, very carefully planted, fail to grow from want of after . This, for the first season, consists in seeing that a cient supply of moisture is present about the roots.

n time of drought, watering may be avoided by covering ground, for several feet about the tree, with mulch, five ix inches deep, or by stirring the surface soil once or e each week. Trees planted in turf are especially liable n the moisture being taken up by the surrounding grass s. This can only be prevented by covering the ground a mulch of any waste material, like corn stover, old , straw, shavings, sawdust, fine brush, cider pomace, dow mud or peat.

he same result may be obtained by packing the loose es often found about the trees. Mulching material of kind should not be in contact with the trunk of the s from Nov. 1 to May 1, unless they are protected by king up, or by a tin or tar-paper band about them to pro- from injury by mice.

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VALUATION OF FERTILIZI
FERTILIZER ANALYS

To assist the farmers, not yet familiar v
mode of determining the commercial value
stances offered for sale in our markets, son
tial considerations, which serve as a basi
tion, are once more stated within a few su

The valuation of a fertilizer is based on t
value of fertilizing elements, specified by
money value of the higher grades of agricu
and of the higher-priced compound fertiliz
the majority of cases, on the amount and th
of two or three essential articles of plant fo
phoric acid, nitrogen and potash, which the
valuation which usually accompanies the a
goods shall inform the consumer, as far as
garding the cash retail price at which the
essential elements of plant food, in an effi
been offered of late for sale, in our large m

The market value of low-priced materi
nurial purposes, as salt, wood ashes, variou
barnyard manure, factory refuse and waste
ferent descriptions, does not, quite freque
close relation to their chemical composit
varies in different localities. Local facilitie
portation, and more or less advantageous m
tion for speedy action, exert, as a rule, a
on their selling price.

The wholesale market price of manuri
liable to serious fluctuations; for supply an
here, as well as in other branches of comme
controlling influence on their temporary m
farmers have only in exceptional instances a
to inform themselves regarding conditions v
market price, the assistance rendered in th

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cultural chemists charged with the examination of com-
cial fertilizers, cannot otherwise but benefit, ultimately,
farmers and manufacturers.

ne market reports of centres of trade in New England,
York and New Jersey, aside from consultations with
ing manufacturers of fertilizers, furnish the necessary
mation regarding the current trade value of fertilizing
edients. The subsequent statement of cash values in
retail trade is obtained by taking the average of the
esale quotations in New York and Boston, during the
nonths preceding March 1, 1887, and increasing them
wenty per cent., to cover expense for sales, credits, etc.
nese trade values, except those for phosphoric acid,
ble in ammonium-citrate, were agreed upon by the Ex-
nent Stations of Massachusetts, Connecticut and New
ey, for use in their several States for the present season.

RADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1887. Cents per Pound.
gen in nitrates,	16
gen in ammoniates,	17½
nic nitrogen in dried and fine-ground fish,	17½
nic nitrogen in Peruvian guano, blood, meat, azotin, ammo-ite, and castor pomace,	17½
nic nitrogen in fine-ground bone and tankage,	16
nic nitrogen in fine medium bone and tankage,	14
nic nitrogen in medium bone and tankage,	12
nic nitrogen in coarse medium bone and tankage,	10
nic matter in coarse bone, horn shavings, hair and fish scraps,	8
phoric acid, soluble in water,	8
phoric acid, soluble in ammonia citrate,*	7½
phoric acid, insoluble, in dry, fine-ground fish, in fish bone nd tankage,	7
phoric acid, insoluble, in fine, medium bone and tankage,	6
phoric acid in medium bone and tankage,	5
phoric acid in coarse medium bone and tankage,	4
phoric acid in coarse bone and tankage,	3
phoric acid in fine-ground rock phosphate,	2
h as sulphate, in compounds free from chlorine,	5½
h as kainite,	4¼
h as muriate,	4¼

ssolved from two grams of phosphate, unground, by 100 c.c. neutral solution monium citrate, sp. gr. 1.09, in 30 minutes, at 65 deg. C., with agitation once in inutes, commonly called "reverted" or "backgone" phosphoric acid.

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The above trade values are the figures at w
1, the respective ingredients could be boug
cash per pound in our leading markets in the
which are the regular source of supply.

They also correspond to the average whol
the six months, ending March 1, plus 20 per
goods for which we have wholesale quotatior
lated values obtained by the use of the above
found to agree fairly with the reasonable reta
of standard raw materials, such as:—

Sulphate of Ammonia,	Dried Grou
Nitrate of Soda,	Azotin,
Muriate of Potash,	Ammonite,
Sulphate of Potash,	Castor Pom
Dried Blood,	Bone,
Dried Ground Meat,	Plain Super

Trade Values in Superphosphates, Spe and Mixed Fertilizers of High

The organic nitrogen in these classes of
valued at the highest figures laid down in the
of Fertilizing Ingredients in Raw Materials;
cents per pound, it being assumed that the o
is derived from the best sources, namely, an
meat, blood, bones or other equally good
from leather, shoddy, hair, or any low-price
of vegetable matter, unless the contrary is as

Insoluble phosphoric acid will be valued a
being assumed, unless found otherwise, that
or similar sources, and not from rock phos
latter form the insoluble phosphoric acid is
cents per pound. Potash is rated at 4¼ cer
chlorine is present in the fertilizer to comb
make muriate. If there is no more potash p
combine with the chlorine, then the excess of
counted as sulphate. To introduce large
chlorides, common salt, etc., into a fertilize
phate of potash as a constituent, is a practic
present state of information, will be conside

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erit. The use of the highest trade values is based on the inion that these articles ought to contain the most efficient rms of fertilizing ingredients. In most cases the valuation the ingredients in superphosphates and specials falls be- w the retail price of these goods. The difference between e two figures represents the manufacturers' charges for nverting raw materials into manufactured articles. These arges are for grinding and mixing, bagging or barreling, rage and transportation, commission to agents and dealers, g credits, interest on investment, bad debts, and, finally, ofits.

Local disadvantages for transportation exert, not infre- ently, a serious influence on the cost of one and the same nd of fertilizers. Binding rules cannot be laid down re- rding these points. Farmers must judge for themselves ether the difference between our valuation and the prices ked for is a fair one, considering local conditions of pply.

The prices stated in these bulletins, in connection with lyses of commercial fertilizers, refer to their cost per ton 2,000 pounds on board of car or boat near the factory, place of general distribution. To obtain the valuation of ertilizer (*i. e.*, the money worth of its fertilizing constit- nts), we multiply the pounds per ton of nitrogen, etc., the trade value per pound. We thus get the values per of the several ingredients, and, adding them together, we the total valuation per ton.

The mechanical condition of any fertilizing material, nple or compound, deserves the most serious consideration farmers, when articles of a similar chemical character are ered for their choice. The degree of pulverization con- ls, almost without exception, under similar conditions, rate of solubility, and the more or less rapid diffusion of different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence the pecuniary value, in case of one and the same kind of stance. Two samples of fish fertilizer, although equally re, may differ from fifty to one hundred per cent. in com- rcial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse

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material of various descriptions, sent to the
amination, are valued with reference to the n
their principal constituents, taking into consi
same time, their general fitness for speedy ac

A large percentage of commercial fertilizin
sists of refuse matter from various industries
sition of these substances depends on the mo
ure carried on. The rapid progress in our
industry is liable to affect, at any time, more o
the composition of the refuse. A constant i
character of the agricultural chemicals, and
manurial refuse substances offered for sale,
secure confidence in their composition, and to
cial disappointment in consequence of the
This work is carried on for the purpose of ai
ing community in a clear and intelligent appr
substances for manurial purposes.

Consumers of commercial manurial substa
buy, whenever practical, on guaranty of co
reference to their essential constituents, and
the bill of sale recognizes that part of the
mistake or misunderstanding in the trans
readily adjusted, in that case, between t
parties. The responsibility of the dealer end
ing an article corresponding in its compos
lowest-stated quantity of each specified essent

Sulphate of Ammonia.

[Sent on from Amherst, Mass. Two sample

Moisture at 100° C.,	
Nitrogen (17½ cents per pound),	2
Sulphuric acid,	5
Valuation per 2,000 pounds,	$75

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Nitrate of Soda.

[Sent on from Ashby, Mass.]

	Per Cent.	
	I.	II.
isture at 100° C.,	.96	1.35
rogen (16 cents per pound),	14.66	16.14
phuric acid,	Trace.	–
orine,	Trace.	–
uation per 2,000 pounds,	$47 01	$51 65

Sulphate of Magnesia.

[Sent on from Amherst, Mass.]

	Per cent.
isture at 100° C.,	29.01
gnesium oxide,	15.87
phuric acid,	30.35
oluble matter,	6.29

Ammonite.

[Sent on from Southampton, Mass.]

	Per cent.
isture at 100° C.,	6.17
,	9.56
rogen (17½ cents per pound),	12.20
osphoric acid (6 cents per pound),	3.40
oluble matter,	0.22
uation per 2,000 pounds,	$47 50

The material was in a fine mechanical condition, and thus a favorable form for speedy disintegration.

Saltpetre Waste.

[Sent on from South Acton, Mass.]

	Per cent.
isture at 100° C.,	2.71
lium oxide,	45.92
assium oxide (4¼ cents per pound),	6.11
cium oxide,	0.71
phuric acid,	0.84
rogen in nitric acid (16 cents per pound),	0.80
orine,	56.00
luation per 2,000 pounds,	$7 75

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The sample contained less nitric acid and
than previous samples.

Felt Factory Waste.

[Sent on from Lowell, Mass.]

Moisture at 100° C., ...
Organic and volatile matter, ...
Ash, ...
Nitrogen (eight cents per pound), ...
Insoluble matter, ...

Valuation per 2,000 pounds, ...

The principal part of the ash consisted o
lime. The material ought to be composted
incorporated into the soil. For use in stables
ent it deserves commendation.

Cotton-seed Meal.

[I. Sent on from Boston, Mass. II. Sent on from Ash

	I
Moisture at 100° C., ...	10.
Ash, ...	5.
Phosphoric acid (6 cents per pound), . . .	2.
Magnesium oxide, ...	.
Potassium oxide (4¼ cents per pound), . .	1.
Sodium oxide, ...	.
Ferric oxide, ...	.
Calcium oxide, ...	.
Nitrogen (17 cents per pound), ...	4.
Insoluble matter, ...	.
Valuation per 2,000 pounds, ...	$18

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Sea-weed Ashes.

[Sent on from Duxbury, Mass.]

	Per cent.
oisture at 100° C.,	1.47
alcium oxide,	6.06
agnesium oxide,	4.37
otassium oxide,	0.92
odium oxide,	8.72
hosphoric acid,	0.30
ulphuric acid,	2.98
hlorine,	6.60
ulphur,	0.14
soluble matter (before calcination),	63.65
soluble matter (after calcination),	56.28

The analysis of the above ash showed it to contain .14 er cent. of magnesium chloride.

Mussel and Mud.

[Sent on from Eastham, Mass.]

	Per cent.
oisture at 100° C.,	2.24
osphoric acid (5 cents per pound),	0.35
lcium oxide,	23.39
on and alumina,	8.26
trogen (15 cents per pound),	0.72
soluble matter,	37.60
luation per 2,000 lbs.,	$2 50

Sea-weed.

[Sent on from Eastham, Mass.]

	Per Cent.	
	I.	II.
oisture at 100° C.,	12.05	14.96
rric oxide,	0.25	0.09
lcium oxide,	2.73	3.86
osphoric acid,	0.44	0.17
gnesium oxide,	1.48	1.30
dium oxide,	11.75	8.40
tassium oxide,	3.81	0.36
lorine,	6.40	5.28
trogen,	1.66	1.28
soluble matter,	7.73	0.78

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Muck.

[Sent on from Peabody, Mass.]

Moisture at 100° C., ...
Dry matter, ...
Ash in fresh muck, ...
Nitrogen in fresh muck, ...

The ash contained a considerable portion o
magnesia compounds. The material is a fair spec
kind.

German Peat.

[Sent on from Millbury, Mass.]

Moisture at 100° C., ...
Nitrogen in organic matter (8 cents per pound), . .
Ash constituents, ...
Insoluble matter (in ash), ...

Valuation per 2,000 pounds, ...

The material was well dried, and evidently d
serve as an absorbent in some branch of manufac

Muriate of Potash.

[Sent on from Ashby, Mass. Four samples.]

	Per Ce		
	I.	II.	
Moisture at 100° C., ...	0.15	1.16	
Potassium oxide (4¼ cents per pound), .	51.87	53.33	
Sodium oxide, ...	–	–	
Chlorine, ...	–	–	
Valuation per 2,000 pounds, ...	$44 09	$45 33	$4

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Muriate of Potash.

[I. Sent on from Fitchburg, Mass. II. Sent on from North Hadley, Mass. III. Sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
oisture at 100° C.,	0.15	1.05	1.86
otassium oxide (4¼ cents per pound),	51.87	48.60	49.98
dium oxide,	–	5.70	–
lorine,	–	43.20	–
luation per 2,000 pounds,	$44 09	$41 31	$42 48

Sulphate of Potash and Magnesia.

Sent on from Amherst, Mass. II. Sent on from Ashby, Mass. III. Sent on from Ashby, Mass]

	Per Cent.		
	I.	II.	III.
oisture at 100° C.,	3.85	7.73	0.34
agnesium oxide,	13.66	12.90	–
otassium oxide (5½ cents per pound),	22.63	22.70	51.28
dium oxide,	6 34	4.22	–
lphuric acid,	47.28	45.61	46.41
lorine,	2.64	1.46	–
soluble matter,	0.80	0.46	0.93
luation per 2,000 pounds,	$24 89	$24 97	$56 41

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Wood Ashes.

[I. and II. Sent on from Sunderland, Mass. III. Sent on frou
IV. Sent on from Boston, Mass. V. Sent on from Am

	Per		
	I.	II.	
Moisture at 100° C.,	11.39	10.97	
Phosphoric acid,	1.71	1.19	
Magnesium oxide,	3.32	3.20	
Calcium oxide,	37.25	36.46	3
Potassium oxide,	6.14	6.28	
Insoluble matter (before calcination),	10.83	17.45	2
Insoluble matter (after calcination),	7.71	12.01	1

These samples are of good quality, with tl
No. V. Unleached wood ash sells in our
24 to 25 cents per bushel of from 42 to 44 p

Wood Ashes.

[I. Sent on from New York City, N. Y. II. Sent on from
III. Sent on from Methuen, Mass. IV. Sent on from E

	I	
	I.	II
Moisture at 100° C.,	4.73	14.
Phosphoric acid,	–	0.
Calcium oxide,	–	36.
Magnesium oxide,	–	2.
Potassium oxide,	3.40	7.
Insoluble matter (before calcination),	22.49	6.
Insoluble matter (after calcination),	15.42	5.

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Wood Ashes.

[Sent on from South Deerfield. Four samples.]

	Per Cent.			
	I.	II.	III.	IV.
oisture at 100° C.,	14.09	13.31	14.71	12.37
hosphoric acid,	1.38	1.38	1.17	.98
agnesium oxide,	3.35	3.48	3.57	3.58
alcium oxide,	36.90	37.74	36.32	36.26
otassium oxide,	6.72	4.86	6.85	6.77
soluble matter (before calcination),	8.20	7.46	14.65	17.78
soluble matter (after calcination),	6.42	5.80	9.14	10.45

Canada Wood Ashes.

. Hard-wood ashes. Sent on from Stockbridge, Mass. II. Sent on from Granby, Mass.]

	Per Cent.	
	I.	II.
oisture at 100° C.,	19.16	13.53
osphoric acid,	1.32	1.31
lcium oxide,	34.80	36.63
agnesium oxide,	3.04	3.12
otassium oxide,	5.65	6.22
soluble matter (before calcination),	7.48	9.22
soluble matter (after calcination),	5.64	6.95

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Wood Ashes.

[Sent on from Amherst, Mass.]

	I.
Moisture at 100° C.,	17.22
Calcium oxide,	34.28
Magnesium oxide,	3.96
Potassium oxide,	4.42
Phosphoric acid,	1.54
Insoluble matter (before calcination),	16.82
Insoluble matter (after calcination),	12.46

Lime-kiln Ashes.

[Sent on from South Deerfield, Mass.]

Moisture at 100° C.,
Phosphoric acid,
Calcium oxide,
Magnesium oxide,
Potassium oxide,
Insoluble matter (before calcination),
Insoluble matter (after calcination),

Wood Ashes (Canada).

[I. and II. Sent on from Boston, Mass. III. Sent on from
IV. Sent on from Concord, Mass.]

	P	
	I.	II.
Moisture at 100° C.,	11.12	8.6
Phosphoric acid,	2.05	1.5
Magnesium oxide,	3.30	3.1
Calcium oxide,	39.15	39.7
Potassium oxide,	5.30	5.3
Insoluble matter (before calcination),	9.80	10.1
Insoluble matter (after calcination),	8.67	9.1

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Nos. 1, 2 and 4 are unleached Canada ashes; the large ount of moisture and of insoluble matter in No. 4 ex- ns its lower percentage of potash. Sample No. 3 is a ially leached ash.

Cotton-seed Hull Ashes.

[Sent on from North Hadley, Mass.]

	Per Cent.	
	I.	II.
ture at 100° C.,	7.40	8.08
ssium oxide (5½ cents per pound),	28.55	26.62
nesium oxide,	16.14	17.15
phoric acid (6 cents per pound),	8.97	11.50
ium oxide,	10.58	11.37
uble matter,	11.71	5.38
ation per 2,000 pounds,	$42 17	$43 08

hese samples contain an exceptionally high percentage otassium oxide and of phosphoric acid.

Cotton-seed Hull Ashes.

[Sent on from North Hadley, Mass.]

	Per Cent.	
	I.	II.
ture at 100° C.,	12.34	22.30
sium oxide (5½ cents per pound),	22.08	31.72
nesium oxide,	10.78	4.67
phoric acid (6 cents per pound),	10.32	2.89
um oxide,	6.64	3.35
uble matter (before calcination),	20.08	7.59
uble matter (after calcination),	17.06	7.30
ation per 2,000 pounds,	$36 67	$38 36

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Soap-grease Residue.

[Sent on from South Lincoln, Mass.]

Moisture at 100° C., ...
Total phosphoric acid (5 cents per pound), . .
Insoluble phosphoric acid, ...
Reverted phosphoric acid, ...
Potassium oxide (4¼ cents per pound), . . .
Nitrogen (12 cents per pound), ...
Insoluble matter, ...

Valuation per 2,000 pounds, ...

Soup from Horse-rendering Establis

[Sent on from Arlington, Mass.]

Moisture at 100° C., ...
Total phosphoric acid (6 cents per pound), . .
Nitrogen (15 cents per pound), ...

Valuation per 2,000 pounds, ...

Fish.

[I. Dried Fish; sent on by Swanzey Farmers' Club, Swanzey, I
Potash; sent on from Medfield, Mass. III. Fish Bone and P
Concord, Mass.]

	I.	
Moisture at 100° C., ...	9.17	
Total phosphoric acid, ...	7.92	
Soluble phosphoric acid, ...	0.64	
Reverted phosphoric acid, ...	4.36	
Insoluble phosphoric acid, ...	2.92	
Potassium oxide, ...	None.	
Nitrogen, ...	8.73	
Insoluble matter, ...	2.69	
Valuation per 2,000 pounds, ...	$39 87	

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Ground Bones.

[Sent on from Westford, Mass.]

	Per Cent.	
	I.	II.
sture at 100° C.,	3.94	9.74
l phosphoric acid,	27.73	12.85
ble and reverted phosphoric acid (7½ cents r pound),	6.10	4.72
luble phosphoric acid (5 cents per pound),	21.63	8.13
ogen (15 cents per pound),	1.83	2.93
luble matter,	0.10	2.61
uation per 2,000 pounds,	$36 27	$23 90

'he mechanical condition of both samples was much the e; the valuation above given has been for this reason same. The desirability of having ground bones sold y by a guaranteed composition finds an additional strong stration in this case.

Ground Bone.

[Sent on from Concord, Mass.]

	Per cent.
sture at 100° C.,	3.05
l phosphoric acid,	17.72
erted phosphoric acid (7½ cents per pound),	5.55
luble phosphoric acid (4 cents per pound),	12.17
ogen (15 cents per pound),	5.15
luble matter,	1.19
uation per 2,000 pounds,	$33 52

Steamed Bone and Meat.

[Sent on from Fitchburg, Mass.]

	Per cent.
sture at 100° C.,	4.71
l phosphoric acid (5 cents per pound),	20.28
ble phosphoric acid,	0.56
erted phosphoric acid,	4.54
luble phosphoric acid,	14.18
ogen (15 cents per pound),	5.37
luble matter,	1.19
uation per 2,000 pounds,	$35 25

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Ground Rock Phosphate.

[Sent on from West Springfield, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid (2 cents per pound),	
Magnesium oxide,	
Calcium oxide,	
Ferric and aluminum oxides,	
Insoluble siliceous matter,	

The material is of but little value for mar without a previous treatment with sulphuric its phosphoric acid available.

South Carolina Rock Phospha

[Sent on from Ashby, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Insoluble matter,	

The material is of fair composition, and ou factured into superphosphate before used.

Natural Phosphate.

[Sent on from New York.]

Moisture at 100° C.,	
Total phosphoric acid,	
Reverted phosphoric acid,	
Insoluble phosphoric acid,	
Alumina and ferric oxides,	
Calcium oxide,	

The article is characterized by the prese amount of sesquioxide of iron and alumina. periments have to decide its agricultural valu

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Carib Guano.

t on from Baltimore, Md. I. Rock; coarse. II. Fine-ground. III. Soil.]

	Per Cent.		
	I.	II.	III.
ure at 100° C.,	2.12	2.16	15.80
phosphoric acid,	35.43	33.09	21.72
le phosphoric acid,	–	–	0.12
ted phosphoric acid,	3.78	3.49	0.44
ble phosphoric acid,	31.65	29.60	21.16
nitrogen,	–	–	0.56
gen as ammoniates,	–	–	0.28
gen as nitrates,	–	–	0.26
m oxide,	44.74	43.26	–
ble matter,	0.60	1.59	7.15

e valuation of this material depends in a controlling ee on its mechanical condition.

Superphosphates.

on from Ashby, Mass. I. and II. Dissolved Bone-black. III. and IV. Acid Phosphate.]

	Per Cent.			
	I.	II.	III.	IV.
re at 100° C.,	13.83	13.86	16.39	13.93
phosphoric acid,	18.21	16.37	14.68	13.84
e phosphoric acid (8 cents per nd),	14.59	14.60	10.50	10.91
ted phosphoric acid (7½ cents per nd),	3.41	1.53	3.82	0.69
ble phosphoric acid (3 cents per nd),	0.21	0.24	0.36	2.24
ble matter,	3.52	2.09	7.89	9.54
ion per 2,000 pounds,	$28 59	$25 80	$22 75	$19 84

ese articles are of fair quality.

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Marl.

[I. and II. Sent on from Baltimore, Md. III. Sent on fron
Mass.]

	I.
Moisture at 100° C.,	16.70
Phosphoric acid,	0.09
Sulphuric acid,	1.00
Carbonic acid,	4.23
Calcium oxide,	9.21
Magnesium oxide,	0.25
Potassium oxide,	0.61
Insoluble matter (before calcination),	59.59
Insoluble matter (after calcination),	–

I. and II. Are samples of "green marl
to a valuable class of marls.

III. This material, sent on "as a samp
essentially a carbonate of lime of fine aggre
soft texture; and for this reason it deserve
tion for agricultural purposes, wherever an a
will benefit the soil in the interest of the crop

Peruvian Guano.

[Sent on from Taunton, Mass.]

Moisture at 100° C.,	
Total phosphoric acid,	
Soluble phosphoric acid (8 cents per pound),	
Reverted phosphoric acid (7½ cents per pound),	
Insoluble phosphoric acid (3 cents per pound),	
Potassium oxide (4¼ cents per pound),	
Total nitrogen,	
Actual ammonia (17½ cents per pound),	
Organic nitrogen (17½ cents per pound),	
Nitrogen as nitric acid (16 cents per pound),	
Insoluble matter,	
Valuation per 2,000 pounds,	

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Compound Fertilizers.

[ent on from Millbury, Mass. II. Sent on by Swanzey Farmers' Club, Swanzey, Mass.]

	Per Cent.	
	I.	II.
sture at 100° C.,	11.83	7.69
l phosphoric acid,	13.95	9.91
ble phosphoric acid,	6.62	2.81
erted phosphoric acid,	2.69	3.57
luble phosphoric acid,	4.64	3.53
ssium oxide,	3.28	10.64
ogen,	2.88	4.62
luble matter,	3.82	1.81
uation per 2,000 pounds,	$30 28	$37 19

Compound Fertilizers.

Animal fertilizer; sent on from Boston. II. Sent on from Eastham, Mass. III. Sent on from Tewksbury, Mass. IV. Peruvian guano; sent on from Taunton, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
sture at 100° C.,	7.20	8.81	14.15	12.17
l phosphoric acid,	14.51	3.97	13.69	18.45
ble phosphoric acid,	6.34	0.25	7.00	1.54
erted phosphoric acid,	6.74	2.96	4.83	5.92
luble phosphoric acid,	1.43	0.76	1.86	10.99
ssium oxide,	5.11	2.97	2.96	3.46
ium oxide,	–	–	16.65	–
l nitrogen,	3.44	1.39	2.40	5.13
ogen in ammoniates,	–	–	–	3.94
ogen in nitrates,	–	–	–	0.33
ogen in organic matter,	–	–	–	0.86
luble matter,	1.23	65.16	5.52	13.64
uation per 2,000 pounds,	$37 49	$12 69	$30 49	$38 73

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Miscellaneous Analyses.

Vinegars.

[Sent on from Prescott, Mass. I. Made Oct. 5, 1885, from un shrinkage, 1¼ gals. on 10, or 12½ per cent. II. Made Oc Baldwin apples; shrinkage not determined. III. Made sweet apples; shrinkage, 1 gal. on 7, or 14 2-7 per cent.]

	I.
Temperature, C.,	11.1
Specific gravity,	1.016
Acetic acid,	6.67
Sulphuric acid and chlorine,	Trace.
Solids at 100° C.,	1.44

The tests were made Jan. 24, 1887.

[Two samples, sent on from Montague, Ma

	I.
Total acids,	4.90 per c

Milk.

[Seven samples; sent on from Hardwick, M

	Specific Gravity.	Temperature, C.	Solids.
No. 1,	1.0338	17°	10.27
2,	1.0329	17°	10.02
3,	1.0323	17°	9.67
4,	1.0323	17°	13.74
5,	1.0335	17°	9.19
6,	1.0320	17°	11.47
7,	1.0311	17°	15.62

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Analysis of Water sent on for Examination.

[Parts per Million.]

nber.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clarks' degree).	Lead.	Locality.
. .	14.80	2.20	148.00	0.682	0.258	19.76	-	Millis.
. .	-	-	-	-	-	-	None.	No. Amherst.
. .	0.03	0.14	16.00	130.00	73.2	26.70	-	Westford.
. .	2.460	1.620	5.00	0.0396	0.0220	-	-	Millis.
. .	Contain	ed free	acid, la	rge amou	nts of SO_3.	Traces	of Fe.	Amherst.
. .	0.10	0.18	23.30	178.00	112.80	31.20	-	Athol.
. .	0.03	0.09	6.00	56.00	45.60	13.50	-	So. Amherst.
. .	0.05	0.16	92.80	462.00	360.00	8.86	-	Rutland.
. .	0.69	0.09	55.60	392.00	216.00	7.43	-	Amherst.
. .	0.15	0.11	10.00	36.00	13.80	1.27	-	Westford.
. .	-	-	-	-	-	-	None.	Amherst.
. .	0.18	0.36	72.50	584.00	231.00	-	-	Marblehead.
. .	0.04	0.02	21.00	194.00	-	3.66	-	Amherst.
. .	0.34	0.47	18.00	139.00	91.00	3.77	-	Amherst.
. .	SO_3—	42.20	7.20	90.00	38.00	CaO —	46.00	Bellows Falls.
. .	0.05	0.10	9.10	164.00	86.00	6.57	-	No. Hadley.
. .	0.10	0.09	6.00	120.00	66.00	6.00	-	No. Hadley.
., .	0.03	0 08	48.00	186.00	84.00	6.29	-	No. Hadley.
. .	4.75	0.20	74.00	706.00	252.00	5.43	-	Amherst.
. .	4.72	0.28	56.00	386.00	234.00	5.14	-	Hadley.
. .	0.07	0.04	18.00	214.00	48.00	2.86	-	So. Amherst.
. .	-	0.04	2.00	52.00	20.00	0.48	-	So. Amherst.
., .	0.08	0.15	8.00	132.00	104.00	-	-	Pawtucket, R.I.
., .	1.225	0.70	11.00	202.00	140.00	-	-	Amherst.
. .	0.07	0.32	9.00	258.00	194.00	-	-	Amherst.
., .	0.02	0.21	3.50	79.00	37.00	-	-	Amherst.
I., .	-	-	-	-	-	-	Present.	Amherst.
II., .	0.22	0.18	9.00	66.00	40.00	1.11	-	Attleboro'.
., .	3.45	0.90	5.40	110.00	70.00	3.90	-	No. Amherst.
. .	0.14	0.08	150.00	652.00	126.00	11.05	-	Amherst.
., .	-	-	-	-	-	-	Present.	East Amherst.
I., .	-	-	-	-	-	-	Present.	Amherst.
II., .	-	-	-	-	-	-	None.	East Amherst.
V., .	-	-	-	-	-	-	None.	Amherst.
., .	3.50	0.50	73.00	692.00	258.00	11.20	None.	Amherst.
I., .	0.26	0.26	36.00	344 00	130.00	7.43	-	Springfield.
II., .	0.48	0.13	13.50	64.00	44.00	-	-	So. Amherst.
III., .	0.044	0.098	6.00	50.00	32.00	1.11	None.	Amherst.
X, .	0.12	0.15	None.	22.00	20.00	1.27	-	Westhampton.
. .	0.13	0.20	18.00	150.00	86.00	1.95	None.	Athol.

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The above-stated results of analyses of dri were obtained from samples sent on, for that p various parts of the State. In most instances t are accompanied by a specified instruction, r object of the party interested, — a circumstanc ders the task of the chemist, comparatively easy one.

The analyses have been made according to process, familiar to chemists; and are directed indications of the presence of chlorine, free an ammonia, and the poisonous metals, lead i (For a more detailed description of this " Water Analyses," by J. A. Wancklyn and man.)

Mr. Wancklyn's interpretation of the results of investigation is as follows: —

1. Chlorine alone does not necessarily indic ence of filthy water.

2. Free and albuminoid ammonia in water, w ine, indicates a vegetable source of contaminati

3. More than five grains per gallon* of chlo parts per million), accompanied by more than million of free ammonia and more than .1 million of albuminoid ammonia, is a clear in the water is contaminated with sewage, dec matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free one-tenth part per million of albuminoid ammo water very suspicious, even without much chlo

5. Albuminoid ammonia over .15 parts per to absolutely condemn the water which contains

6. The total solids found in the water shoul forty grains per gallon (571.4 parts per million

An examination of the above results of an that Nos. 3, 7, 8, 16, 17, 21, 23 and 25 are of character, and that Nos. 1, 4, 6, 9, 10, 12, 14 28, 30, 35 and 36 ought to be condemned, on large amount of free and albuminoid ammon likely to access of sewage waters. Of eigh

* One gallon equals 70,000 grains.

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ater tested for lead, three were found to be poisoned by at metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm, epends, in a controlling degree, on a judicious selection of e location of the well designed for the use of the family nd for the live-stock, and on the personal attention be-owed, from time to time, on the condition of the well and s surroundings. Good wells are liable to change for the orse at any time, on account of circumstances too numerous state in this connection. To ascertain, from time to time, e exact condition of the well which supplies the wants of e family and of the live-stock, is a task which no farmer n, for any length of time, discard, without incurring a rious risk to health and prosperity.

The subject receives, quite frequently, but little attention, account of the fact that the harmful qualities which an parently good water may contain, are disguised beyond cognition by the unaided senses. Certain delicate chemi-l tests, aided at times by microscopic observations, are, in e majority of cases, the only reliable means, in our pres-t state of scientific inquiry, by which desirable informa-on regarding the true character of a drinking water can be tained.

Parties sending on water for an analysis ought to be very reful to use clean vessels, clean stoppers, etc. The sam-le should be sent on without delay after collecting. One allon is desirable for the analysis.

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COMPILATION OF ANALYSES,

MADE AT THE

AGRICULTURAL INSTITUTIONS AT AMHERST, MASS.,

OF FODDER ARTICLES.

1868–1888.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles, with Reference to Fertilizing Ingredients.

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"A.'

CORN (ZEA MAIZE).

Fodder Analyses of Kernels.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Wheeler's Prolific,	B'd of Agricul. '79-80,	10.00	90.00	1.60	2.10	5.24	13.81	77.25	34.	76.	85.	94.	1:7.10
Clark Corn,	" "	10.00	90.00	1.84	2.78	5.40	13.80	76.18	34.	76.	85.	94.	1:7.07
Tip Corn,	" "	10.00	90.00	1.71	2.78	5.77	14.11	75.63	34.	76.	85.	94.	1:7.13
Southern Corn,	" "	10.00	90.00	1.52	2.24	4.98	13.84	77.42	34.	76.	85.	94.	1:7.06
Canada Corn,	" "	10.00	90.00	1.49	2.78	5.28	13.88	76.57	34.	76.	85.	94.	1:7.03
Canada Dutton,	" "	10.00	90.00	1.59	2.78	5.83	12.06	77.74	34.	76.	85.	94.	1:8.30

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Hampden Prolific,	" II.,	8.02	91.98	1.69	1.98	5.29	13.73	77.31	34.	76.	85.	94.	1: 7.15
Topover Corn,	" III.,	11.55	88.45	1.47	1.96	6.61	14.01	75.95	34.	76.	85.	94.	1: 7.11
Yellow Sweet Corn,	" IV.,	10.90	89.10	2.16	2.58	4.25	12.61	78.40	34.	76.	85.	94.	1: 7.74
Self-Husking Corn,	" IV.,	12.10	87.90	1.74	2.52	5.44	12.47	77.83	34.	76.	85.	94.	1: 7.96
Pride of the North,	Bulletin 24,	8.75	91.25	1.59	2.54	4.34	12.05	79.48	34.	76.	85.	94.	1: 8.18
Western Dent,	Bulletin 26,	10.20	89.80	1.47	1.86	4.72	9.31	82.64	34.	76.	85.	94.	1:11.03
Corn Meal,	Report I.,	17.04	82.96	1.58	3.60	4.82	16.08	73.20	34.	76.	85.	94.	1: 5.54
" "	" I.,	13.55	86.45	1.42	2.64	4.24	10.40	81.30	34.	76.	85.	94.	1: 9.66
" "	" II.,	13.85	86.15	1.42	2.64	4.24	10.40	81.30	34.	76.	85.	94.	1: 9.66
" "	" II.,	12.62	87.38	1.56	2.65	4.27	11.43	80.09	34.	76.	85.	94.	1: 8.68
" "	" II.,	11.95	88.05	1.59	2.59	4.43	13.13	78.26	34.	76.	85.	94.	1: 7.42
" "	" II.,	12.40	87.60	1.66	2.71	4.14	10.77	80.72	34.	76.	85.	94.	1: 9.25
" "	" III.,	12.62	87.38	1.56	2.66	4.27	11.43	80.08	34.	76.	85.	94.	1: 8.76
" "	" III.,	11.95	88.05	1.59	2.59	4.43	13.13	78.26	34.	76.	85.	94.	1: 7.42
" "	" IV.,	12.62	87.38	1.56	2.66	4.27	11.43	80.88	34.	76.	85.	94.	1: 8.76
" "	" V.,	13.18	86.82	1.57	3.56	4.86	10.72	79.29	34.	76.	85.	94.	1: 9.33
" "	" V.,	12.98	87.02	1.75	3.42	5.08	10.07	79.68	34.	76.	85.	94.	1:10.17

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Fodder Analysis of Corn and Cob (Whole Ear).

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Wheeler's Prolific,	B'd of Agricul. '79-80,	10.00	90.00	1.57	7.39	4.47	12.17	74.40	-	-	-	-	-
Southern Corn,	" "	10.00	90.00	1.37	8.47	4.06	11.78	74.32	-	-	-	-	-
Western (Yellow) Dent,	" "	10.00	90.00	1.57	7.30	4.47	11.13	75.53	-	-	-	-	-
Corn Meal and Cob,	Report I.,	19.07	80.93	1.61	9.77	3.43	15.06	70.13	-	-	-	-	-
Corn-cob Meal,	" IV.,	9.45	90.55	1.64	6.32	5.19	9.85	77.00	-	-	-	-	-
Corn and Cob,	" IV.,	10.71	89.29	2.16	5.39	5.27	12.18	75.00	-	-	-	-	-

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Dried Fodder Corn in tassel (frost-bitten),	Report I.,	8.83	91.17	4.86	29.05	2.00	8.63	55.40	72.	75.	73.	67.	1: 9.82
Fodder Corn,	" II.,	6.65	93.35	4.68	31.39	1.42	6.83	55.68	72.	75.	73.	67.	1:12.54
Fodder Corn (frost-bitten),	" II.,	6.67	93.33	5.11	33.75	1.11	6.17	53.86	72.	75.	73.	67.	1:13.88
From unfertilized plats,	" III.,	78.50	21 50	3.91	25.74	2.92	13.75	53.68	72.	75.	73.	67.	1: 5.97
Fodder Corn,													
Collected July 22,	" III.,	88.61	11.39	8.54	26.01	3.24	17.19	42.02	72.	75.	73.	67.	1: 4.22
" July 29,	" III.,	85.76	14.24	8.00	27.29	2.65	14.42	47.64	72.	75.	73.	67.	1: 5.37
" Aug. 5,	" III.,	84.64	15.36	5.95	26.40	2.26	11.86	53.53	72.	75.	73.	67.	1: 6.83
" Aug. 13,	" III.,	82.08	17.92	5.69	24.11	2.13	11.23	56.84	72.	75.	73.	67.	1: 7.25
" Aug. 27,	" III.,	81.15	18.85	4.70	24.30	1.81	8.87	60.32	72.	75.	73.	67.	1: 9.46
" Sept. 3,	" III.,	76.81	23.19	4.22	20.93	2.63	9.17	63.05	72.	75.	73.	67.	1: 9.30
Collected Sept. 1,	" V.,	72.27	27.73	3.16	24.32	2.89	9.64	59.99	72.	75.	73.	67.	1: 8.97
Kernels glazed,													
Fodder Corn for Ensilage,	" V.,	70.27	29.73	5.24	24.50	3.38	8.36	58.52	72.	75.	73.	67.	1:10.36

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Fodder Analysis of Corn Fodder (Stover).

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Corn Stover,	Report II.,	8.73	91.27	3.12	34.28	1.27	6.58	54.75	–	30.	40.	100.	1:21.16
Shredded Stover,	" III.,	6.95	93.05	5.16	33.46	1.71	12.15	47.52	72.	75.	73.	67.	1: 7.23
Corn Fodder,	" IV.,	15.40	84.60	4.22	20.93	2.63	9.17	63.05	72.	75.	73.	67.	1: 9.3
Western Dent Stover,	Bulletin 26,	16.67	83.33	4.17	35.44	1.71	6.63	52.05	72.	75.	73.	67.	1:13.14
"Topover Corn" Stover,	Report III.,	25.00	75.00	6.12	36.10	2.49	6.47	48.82	72.	75.	73.	67.	1:13.43

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Corn Ensilage,	" IV.,	76.90	23.10	5.22	17.67	3.15	8.27	65.69	72.	75.	73.	67.	1:10.4
Corn Ensilage,	Bulletin 26,	71.60	28.40	3.32	18.52	6.07	7.78	64.31	72.	75.	73.	67.	1:11.9

Fodder Analysis of Gluten Meal.

Gluten Meal,	Report I,	8.43	91.57	0.64	3.55	8.75	38.22	48.84	34.	76.	85.	94.	1:1.96
" "	" I.,	10.23	89.77	0.65	1.20	5.06	33.56	59.53	34.	76.	85.	94.	1:2.31
" "	" II.,	11.68	88.32	0.79	.77	3.94	28.24	66.26	34.	76.	85.	94.	1:2.92
" "	" III.,	8.45	91.55	0.76	1.73	9.34	35.31	52.86	34.	76.	85.	94.	1:2.27
" "	" IV.,	8.95	91.05	0.76	1.58	7.51	30.81	59.34	34.	76.	85.	94.	1:3.00
" "	" V.,	8.83	91.17	0.73	.79	8.46	31.43	58.59	34.	76.	85.	94.	1:2.67
" "	" V.,	10.04	89.96	0.78	4.45	9.34	34.67	50.76	34.	76.	85.	94.	1:2.27

Fodder Analysis of Corn Refuse from Factories.

Hominy Feed, Chit and soft parts of Kernels of Corn,	Report I.,	8.93	91.07	2.07	3.77	4.89	11.20	78.07	-	-	-	-	-
Hominy Meal,	" III.,	8.11	91.89	3.24	4.78	12.22	11.76	68.00	34.	76.	85.	94.	1:9.28
Hominy Meal,	" IV.,	10.70	89.30	2.82	3.69	10.88	11.88	70.73	34.	76.	85.	94.	1:8.75
Corn Refuse from Starch Factory,	" IV.,	57.04	42.96	0.90	7.54	10.17	22.41	58.98	-	-	-	-	-
Chit Corn Meal,	" V.,	12.32	87.68	2.08	3.92	5.74	10.26	78.00	-	-	-	-	-
Cracked Corn, Chits removed,	" V.,	13.58	86.42	2.64	3.15	4.06	10.99	79.16	-	-	-	-	-

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WHEAT.

Fodder Analysis of Wheat Grain.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Wheat Grain, ...	Report II., ...	10.58	89.42	2.18	2.42	1.79	13.35	80.26	–	80.	90.	92.5	1:6.42
Fodder Analysis of Wheat Straw.													
Wheat Straw,.	**Report II., ...**	**6.20**	**93.80**	**4.80**	**35.91**	**1.63**	**7.20**	**50.46**	**–**	**42.**	**60.**	**65.**	**1:8.**
Fodder Analysis of Wheat Bran.													
Wheat Bran, ...	**Report I., ...**	**13.70**	**86.30**	**6.76**	**9.33**	**2.91**	**19.56**	**61.44**	**20.**	**80.**	**88.**	**80.**	**1:3.30**
" "	**" I., ...**	**12.08**	**87.92**	**7.92**	**13.72**	**3.81**	**15.67**	**58.88**	**20.**	**80.**	**88.**	**80.**	**1:4.16**

Fodder Analysis of Wheat Middlings.

Wheat Middlings,	Report III.,	9.25	90.75	5.34	8.40	6.46	18.18	61.62	20.	80.	88.	80.	1:3.99
" "	" IV.,	10.55	89.45	2.49	1.40	4.26	19.21	72.64	20.	80.	88.	80.	1:3.97
" "	" IV.,	9.85	90.15	2.53	2.75	3.19	17.23	74.30	20.	80.	88.	80.	1:4.38

Fodder Analysis of Rye Bran and Middlings.

Rye Bran,	Report I.,	13.70	86.30	5.17	4.54	2.07	18.98	69.24	9.	57.5	66.	74.5	1:4.39
Rye Bran,	" IV.,	8.18	91.82	3.43	3.46	3.03	16.52	73.56	9.	57.5	66.	74.5	1:5.45
Rye Middlings,	Bulletin 27,	12.54	87.46	4.02	3.70	5.61	13.15	73.52	9.	57.5	66.	74.5	1:7.28

Fodder Analysis of Various Fodder Stuffs.

Broom Corn Seed Meal,	Report V.,	13.54	86.46	2.43	8.00	4.13	11.14	74.30	-	-	-	-	-
Broom Corn Seed,	" V.,	14.10	85.90	2.35	8.34	4.05	11.21	74.05	-	-	-	-	-
Broom Corn Waste,	" V.,	8.70	91.30	4.88	39.25	1.00	6.78	48.09	-	-	-	-	-
Linseed Cake,	" I.,	8.35	91.65	7.52	8.69	5.69	37.25	40.85	26.	91.	87.	91.	1:1.62
Cocoa Dust, Refuse from Cocoa Manufactories,	" I.,	7.10	92.90	6.83	5.86	25.85	15.47	45.99	-	-	-	-	-
Pea Meal, Refuse from Pea-splitting Manufactories,	" V.,	8.85	91.15	2.94	19.42	1.67	20.95	55.02	-	-	-	-	-

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Fodder Analysis of Cotton-seed Meal.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Cotton-seed Meal, ...	Report I., . . .	9.13	90.87	7.61	6.28	12.83	47.04	26.24	23.	91.	74.	46.	1:1.23
" " "	" I., . . .	8.38	91.62	8.51	6.73	12.94	42.47	29.35	23.	91.	74.	46.	1:1.41
" " "	" I., . . .	7.10	92.90	9.34	7.53	13.75	42.50	26.80	23.	91.	74.	46.	1:1.44
" " "	" I., . . .	8.15	91.85	7.46	7.41	14.72	36.54	33.87	23.	91.	74.	46.	1:1.88
" " "	" I., . . .	7.09	92.91	9.15	10.53	13.65	41.64	25.03	23.	91.	74.	46.	1:1.46

Fodder Analysis of Ensilage from Various Materials.

Corn and Cob before entering silo,	Report IV., . . .	10.71	89.29	2.16	5.39	5.27	12.18	75.00	-	-	-	-	-

Fodder Analysis of Grasses.

English Hay, cut June 20. Last stage of blooming,	Report III.,	10.55	89.45	4.69	29.21	2.65	9.02	54.43	58.	46.	57.	63.	1:10.6
Hay from Station,	" III.,	8.30	91.70	6.12	30.19	2.55	9.75	51.39	58.	46.	57.	63.	1: 9.5
Hay from Station, '87,	" V.,	10.78	89.22	7.11	35.55	2.63	8.75	45.96	58.	46.	57.	63.	1:10.55
Rowen,	Report IV.,	19.71	80.29	8.99	29.43	4.96	14.70	41.92	58.	46.	57.	63.	1: 5.87
Rowen, Station, '87,	" V.,	8.84	91.16	10.50	29.46	3.05	13.20	43.79	58.	46.	57.	63.	1: 6.41
Herd's Grass or Timothy, fertilized,	Bulletin 24,	65.74	34.26	5.29	33.23	1.95	8.20	51.33	58.	46.	57.	63.	1:11.52
Herd's Grass or Timothy, unfertilized, collected in bloom,	Bulletin 26,	65.00	35.00	5.37	32.50	2.07	8.83	51.23	58.	46.	57.	63.	1:11.86
Timothy, after blooming,	Report I.,	8.70	91.30	4.04	36.59	2.12	7.24	50.01	58.	46.	57.	63.	1:14.83
Timothy, after blooming,	" II.,	10.55	89.45	4.69	29.21	2.65	9.02	54.43	58.	46.	57.	63.	1:10.6
Red Top.													
Collected July 22. Fertilized,	Report V.,	8.24	91.76	4.84	33.49	1.50	6.41	53.76	58.	46.	57.	63.	1:15.07
" July 22. Unfertilized,	" V.,	8.02	91.98	4.17	31.12	1.69	8.28	54.74	58.	46.	57.	63.	1:11 54
" July 5. Fertilized,	" V.,	6.81	93.19	5.69	34.11	1.56	8.32	50.32	58.	46.	57.	63.	1:11.24
" July 5. Unfertilized,	" V.,	7.75	92.25	5.17	32.95	1.64	8.40	51.84	58.	46.	57.	63.	1:11.29

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Fodder Analysis of Grasses — Continued.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Orchard Grass.													
Collected June 7, in bloom, unfertilized,	Report V.,	9.16	90.86	8.67	34.15	2.40	11.29	43.50	58.	46.	57.	63.	1: 7.77
Same, fertilized,	" V.,	9.09	90.91	7.90	34.12	2.41	8.94	46.63	58.	46.	57.	63.	1:10.18
Collected June 30, in seed, unfertilized,	" V.,	8.72	91.28	5.46	35.79	3.26	8.15	47.34	58.	46.	57.	63.	1:11.67
Same, fertilized,	" V.,	8.38	91.62	6.17	35.48	3.56	7.57	47.22	58.	46.	57.	63.	1:12.63
Barnyard Grass.													
Collected, in bloom, Aug. 14,	Report II.,	6.65	93.35	10.82	33.72	1.95	15.27	38.24	-	42.	60.	65.	1: 2.94
Meadow Fescue.													

Pearl Millet, unfertilized, collected Sept. 10,	Report III.,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	42.	60.	65.	1: [illegible]
Pearl Millet, unfertilized, collected Sept. 10,	" III.,	8.10	91.90	7.08	34.30	0.89	8.11	49.62	-	42.	60.	65.	1: 6.8
Hungarian Grass,	" II.,	7.45	92.55	5.73	31.96	2.22	9.45	50.64	-	42.	60.	65.	1: 6.22
Hungarian Grass, in bloom,	" III.,	74.07	25.93	7.15	24 66	1.01	9.38	57.80	-	42.	60.	65.	1: 6.86
Hay of Ripe Oats,	" I.,	8.70	91.30	6 11	36.31	2.61	6.05	48.92	-	46.	57.	100.	1:15.08
Hay of Oats, in blossom,	" I.,	6.43	93.57	6.41	34.06	2.92	6 58	50 03	-	46.	57.	100.	1:14.23
Hay of Oats, Seeds in milk,	" III.,	9.55	90.45	6.08	34.32	2.69	10.89	46.02	-	46.	57.	100.	1: 7.9
Green Oats, in blossom, collected July 5,	Bulletin 24,	78.61	21.39	7 38	33.12	2.02	7.10	50.38	-	46.	57.	100.	1:13.02
Green Oats, collected July 13,	" 24,	71.18	28.82	6.99	32.83	2.44	7.05	50.69	-	46.	57.	100.	1:13.32
Hay of Winter Rye, in full bloom, May 25,	Report I.,	8.55	91.45	6.40	32.97	2.57	10.66	47.40	-	46.	57.	100.	1: 8.28
Hay of Barley, Seeds in milk,	" III.,	10.25	89.75	4.95	29.12	2.76	10.26	52.91	-	46.	57.	100.	1: 9.59

Fodder Analyses of Leguminous Plants.

Alsyke Clover, unfertilized, collected Aug. 16,	Report V.,	8.30	91.70	13.35	21.44	3.26	17.32	44.63	-	-	-	-	-
Alsyke Clover, fertilized, collected Aug. 16,	" V.,	8.64	91.36	10.92	26.28	2.89	14.97	44.94	-	-	-	-	-
Luzerne (Alfalfa), beginning to bloom,	" III.,	16.00	84.00	10.45	25.42	2.50	16.34	45 29	40.	39.	77.	65.	1: 4.71
Sand Luzerne, in bloom,	" III.,	8.80	91.20	9.57	21.27	2.59	16.26	50.31	40.	39.	77.	65.	1: 3.5
Luzerne (Alfalfa); unfertilized, collected Aug. 16,	" V.,	8.41	91.59	7.83	27.86	2.04	12.96	49.31	40.	39.	77.	65.	1: 4.55

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Fodder Analysis of Grasses — Continued.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Orchard Grass.													
Collected June 7, in bloom, unfertilized,	Report V.,	9.16	90.86	8.67	34.15	2.40	11.29	43.50	58.	46.	57.	63.	1: 7.77
Same, fertilized,	" V.,	9.09	90.91	7.90	34.12	2.41	8.94	46.63	58.	46.	57.	63.	1:10.18
Collected June 30, in seed, unfertilized,	" V.,	8.72	91.28	5.46	35.79	3.26	8.15	47.34	58.	46.	57.	63.	1:11.67
Same, fertilized,	" V.,	8.38	91.62	6.17	35.48	3.56	7.57	47.22	58.	46.	57.	63.	1:12.63
Barnyard Grass.													
Collected, in bloom, Aug. 14,	Report II.,	6.65	93.35	10.82	33.72	1.95	15.27	38.24	–	42.	60.	65.	1: 2.94
Meadow Fescue													

Pearl Millet, unfertilized, collected Sept. 10,	" III.,	8.10	91.90	7.08	34.30	0.89	8.11	49.62	-	42.	60.	65.	1: 6.8
Hungarian Grass,	" II.,	7.45	92.55	5.73	31.96	2.22	9.45	50.64	-	42.	60.	65.	1: 6.22
Hungarian Grass, in bloom,	" III.,	74.07	25.93	7.15	24 66	1.01	9.38	57.80	-	42.	60.	65.	1: 6.86
Hay of Ripe Oats,	" I.,	8.70	91.30	6 11	36.31	2.61	6.05	48.92	-	46.	57.	100.	1:15.08
Hay of Oats, in blossom,	" I.,	6.43	93.57	6.41	34.06	2.92	6 58	50 03	-	46.	57.	100.	1:14.23
Hay of Oats, Seeds in milk,	" III.,	9.55	90.45	6.08	34.32	2.69	10.89	46.02	-	46.	57.	100.	1: 7.9
Green Oats, in blossom, collected July 5,	Bulletin 24,	78.61	21.39	7 38	33.12	2.02	7.10	50.38	-	46.	57.	100.	1:13.02
Green Oats, collected July 13,	" 24,	71.18	28.82	6.99	32.83	2.44	7.05	50.69	-	46.	57.	100.	1:13.32
Hay of Winter Rye, in full bloom, May 25,	Report I.,	8.55	91.45	6.40	32.97	2.57	10.66	47.40	-	46.	57.	100.	1: 8.28
Hay of Barley, Seeds in milk,	" III.,	10.25	89.75	4.95	29.12	2.76	10.26	52.91	-	46.	57.	100.	1: 9.59

Fodder Analyses of Leguminous Plants.

Alsyke Clover, unfertilized, collected Aug. 16,	Report V.,	8.30	91.70	13.35	21.44	3.26	17.32	44.63	-	-	-	-	-
Alsyke Clover, fertilized, collected Aug. 16,	" V.,	8.64	91.36	10.92	26.28	2.89	14.97	44.94	-	-	-	-	-
Luzerne (Alfalfa), beginning to bloom,	" III.,	16.00	84.00	10.45	25.42	2.50	16.34	45.29	40.	39.	77.	65.	1: 4.71
Sand Luzerne, in bloom,	" III.,	8.80	91.20	9.57	21.27	2.59	16.26	50.31	40.	39.	77.	65.	1: 3.5
Luzerne (Alfalfa); unfertilized, collected Aug. 16,	" V.,	8.41	91.59	7.83	27.86	2.04	12.96	49.31	40.	39.	77.	65.	1: 4.55

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Fodder Analysis of Leguminous Plants — Concluded

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Luzerne (Alfalfa); fertilized, collected Aug. 16,	Report V.,	8.33	91.67	7.18	28.54	1.54	11.12	51.62	40.	39.	77.	65.	1: 5.43
Vetch, collected in bloom,	" III.,	8.35	91.65	7.97	30.68	2.30	15.76	43.29	54.	60.	76.	65.	1: 4.02
Vetch, collected fully matured,	" III.,	9.45	90.55	8.50	30.05	2.69	14.42	44.34	45.	60.	71.	55.	1: 4.09
Vetch and Oats by weight; 90 per cent. Oats and 10 per cent. Vetch,	" V.,	86.11	13.89	12.37	34.20	2.74	10.59	40.10	–	50.	60.	100.	1: 6.85
Cow Pea, variety, Clay; collected Aug. 1,	" II.,	9.30	90.70	9.53	23.58	3.81	17.02	46.06	47.	59.	60.	60.	1: 4.75
Cow Pea, variety, Whippoorwill; collected Aug. 1,	" II.,	9.65	90.35	10.46	22.36	3.87	16.95	46.36	47.	59.	60.	69.	1: 4.74
Cow Pea, same as previous, mixed with Oats	" II.,	9.75	90.25	7.87	19.06	4.49	17.17	51.41	47.	59.	60.	69.	1: 4.95

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tured,	Report V.,	85.35	14.65	5.03	31.18	2.41	18.71	42.67	47.	50.	60.	60.	1: 6.20
White Lupine, in bloom,	" III.,	85.35	14.65	5.03	31.18	2.41	18.71	42.67	-	-	-	-	-
Horse-bean Straw, collected Sept. 15,	" II.,	9.15	90.85	9.59	41.44	1.51	9.69	37.77	36. (Ratio	55. of Be	51. ans to	61. Straw,	1: 8.55 46:54.)
Horse-bean Straw (Beans), collected Sept. 15,	" II.,	10.28	89.72	4.27	8.11	1.11	30.03	56.48	63.	97.	90.	94.	1: 2.24
Whole Plant, Horse-bean, collected in bloom,	" III.,	84.83	15.17	5.75	28.17	2.31	16.68	47.09	-	67.	71.	60.	1: 2.71

Fodder Analyses of Roots.

Vilmorin Sugar Beet,	Report III.,	84.25	15.75	4.65	6.98	0.64	12.98	74.75	100.	100.	75.	95.	1: 8.17
" " "	" III.,	83.55	16.45	4.53	6.75	0.68	10.14	77.90	100.	100.	75.	95.	1:10.84
" " "	" III.,	80.47	19.53	3.85	6.45	0.58	16.13	72.79	100.	100.	75.	95.	1: 6.37
" " "	" III.,	85.99	14.01	4.27	5.77	0.61	15.75	73.60	100.	100.	75.	95.	1: 6.49
Lane's Improved Sugar Beet,	" III.,	83.57	16.43	3.57	5 27	0.83	17.44	72.89	100.	100.	75.	95.	1: 5.86
Sugar-beet Pulp, refuse from diffusion method,	" II.,	89.68	10.32	1.04	23.74	0.95	12.41	61.86	100.	100.	100.	100.	1: 7.1
Carrots (Danvers),	" III.,	87.48	12.52	4.92	7.55	3.94	9.63	73.96	100.	100.	100.	100.	1: 9.49
Carrots,	Bulletin 26,	90.02	9.98	11.21	10.76	1.89	8.90	67.24	100.	100.	100.	100.	1: 9.24
Southern Prize Turnip,	Report III.,	91.77	8.23	7.85	10.12	1.74	9.67	70.62	100.	100.	57.	88.7	1: 8.8
Yellow Globe Mangold,	" III.,	88.27	11.73	7.83	7.08	0.73	12.84	71.52	100.	100.	75.	95.	1: 6.26

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Fodder Analyses — Concluded.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Potato, fertilized, not matured fully, ...	Report III., . . .	78.05	21.95	4.63	1.98	0.83	13.56	79.00	100.	100.	65.	93.	1: 6.13
R. I. Greening Apples, . . .	" III., . . .	80.32	19.68	2.13	7.05	2.81	4.57	83.44	-	-	75.	100.	1:24.3
Sweet Apples, ...	" III., . . .	75.17	24.83	2.02	6.14	1.71	3.92	86.21	-	-	-	-	-
Apple Pomace, R. I. Greening, .	" III., . . .	78.22	21.78	1.09	16.58	3.19	6.94	70.20	-	-	-	-	-
Apple Pomace of Baldwin, . .	" III., . . .	82.78	17.22	1.82	13.15	4.37	7.73	72.93	-	-	-	-	-
Apple Pomace, Ensilage, . .	" IV., . . .	85.33	14.67	4.21	22.18	7.36	8.22	58.03	-	-	-	-	-

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Fertilizing Ingredients in Corn (Zea Maize; Kernels).

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.*
Wheeler's Prolific,	Mass. Board of Agricul. '79–80,	10.00	-	.773	.369	.015	.210	.031	.013	.018	1.99	$7 91
Southern Corn,	" " "	10.00	-	.719	.383	.014	.212	.026	.011	.005	1.99	7 86
Canada Corn,	" " "	10.00	-	.743	.309	.024	.175	.057	.013	.004	2.00	7 95
Canada Dutton,	" " "	10.00	-	.738	.421	.015	.208	-	.030	.011	1.74	7 16
Western (Yellow) Dent,	" " "	10.00	-	.679	.466	.024	.237	.049	.005	.039	1.78	7 27
Crosby Sweet Corn,	" " "	10.00	-	.742	.712	.032	.222	.021	.003	.027	1.87	7 86
Corn Meal,	Report II.,	17.04	-	.644	.419	.040	.176	-	-	-	2.23	8 71
Corn Meal,	" IV.,	10.00	-	.770	.450	.027	.197	.064	.015	.005	1.86	7 62

Fertilizing Ingredients in Corn and Cob.

Wheeler's Prolific,	Board of Agricul. '79–80,	10.00	1.4116	.676	.433	.017	.198	.038	Trace.	.050	1.752	$7 18
Southern Corn,	" "	10.00	1.2317	.575	.390	.015	.173	.033	.010	.035	1.696	6 79
Western (Yellow) Dent,	" "	10.00	1.4087	.575	.474	.024	.203	.054	.005	.073	1.602	6 54

* On basis of valuation for 1887, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide 4¼ cents, per pound.

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Fodder Analyses — Concluded.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Potato, fertilized, not matured fully, ...	Report III., . . .	78.05	21.95	4.63	1.98	0.83	13.56	79.00	100.	100.	65.	93.	1: 6.13
R. I. Greening Apples, . . .	" III., . . .	80.32	19.68	2.13	7.05	2.81	4.57	83.44	-	-	75.	100.	1:24.3
Sweet Apples, ...	" III., . . .	75.17	24.83	2.02	6.14	1.71	3.92	86.21	-	-	-	-	-
Apple Pomace, R. I. Greening, .	" III., . . .	78.22	21.78	1.09	16.58	3.19	6.94	70.20	-	-	-	-	-
Apple Pomace of Baldwin, . .	" III., . . .	82.78	17.22	1.82	13.15	4.37	7.73	72.93	-	-	-	-	-
Apple Pomace, Ensilage, . .	" IV., . . .	85.33	14.67	4.21	22.18	7.36	8.22	58.03	-	-	-	-	-

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Fertilizing Ingredients in Corn (Zea Maize; Kernels).

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.*
Wheeler's Prolific,	Mass. Board of Agricul. '79–80,	10.00	-	.773	.369	.015	.210	.031	.013	.018	1.99	$7 91
Southern Corn,	" " "	10.00	-	.719	.383	.014	.212	.026	.011	.005	1.99	7 86
Canada Corn,	" " "	10.00	-	.743	.309	.024	.175	.057	.013	.004	2.00	7 95
Canada Dutton,	" " "	10.00	-	.738	.421	.015	.208	-	.030	.011	1.74	7 16
Western (Yellow) Dent,	" " "	10.00	-	.679	.466	.024	.237	.049	.005	.039	1.78	7 27
Crosby Sweet Corn,	" " "	10.00	-	.742	.712	.032	.222	.021	.003	.027	1.87	7 86
Corn Meal,	Report II.,	17.04	-	.644	.419	.040	.176	-	-	-	2.23	8 71
Corn Meal,	" IV.,	10.00	-	.770	.450	.027	.197	.064	.015	.005	1.86	7 62

Fertilizing Ingredients in Corn and Cob.

Wheeler's Prolific,	Board of Agricul. '79–80,	10.00	1.4116	.676	.433	.017	.198	.038	Trace.	.050	1.752	$7 18
Southern Corn,	" "	10.00	1.2317	.575	.390	.015	.173	.033	.010	.035	1.696	6 79
Western (Yellow) Dent,	" "	10.00	1.4087	.575	.474	.024	.203	.054	.005	.073	1.602	6 54

* On basis of valuation for 1887, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide 4¼ cents, per pound.

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Fertilizing Ingredients in Corn Cobs.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.
Wheeler's Prolific,	B'd of Agricul. '79-80.	10.00	1.2729	.117	.765	.028	.068	.073	Trace.	.220	.597	$2 82
Southern Corn,	" "	10.00	0.6783	.054	.406	.021	.031	.016	.008	.141	.503	2 23
Canada Corn,	" "	10.00	0.1629	.017	.102	.004	.008	.005	.011	.017	-	-
Canada Dutton Corn,	" "	10.00	1.1485	.054	.906	.057	.110	-	.020	-	-	-
Western (Yellow) Dent,	" "	10.00	0.8494	.043	.461	.019	.034	.071	.005	.216	.521	2 21
Longfellow,	Report II.,	12.00	1.3800	.075	.909	.036	.044	.031	.016	.269	-	-
Corn Cobs,	" IV.,	10.00	1.0300	.080	.680	.030	.060	.040	.010	.200	.540	2 52

Fertilizing Ingredients in Fodder Corn.

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Fodder Corn, kernels glazed,	" V.,	72.27	-	.40	.54	1.09	.16	.15	-	1.35	1.25	1 09
" " green,	" V.,	70.27	-	.13	.18	.36	.05	.05	-	.45	.41	1 86

Fertilizing Ingredients in Ensilage (from Fodder Corn).

CONDITIONS AND STAGE OF GROWTH.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Ensilage from Corn, kernels glazed,	Bulletin 26,	71.60	-	.14	.10	.33	.09	.05	.02	.04	.36	$1 68

Fertilizing Ingredients in Gluten Meal.

VARIETY.	Source of Analysis.	Sulphuric Acid.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Nitrogen.	Valuation per Ton.
Gluten Meal,	Report I.,	.0215	8.43	.586	.4512	.0582	.0564	.0346	-	-	5.5997	$19 63
" "	" IV.,	.021	9.00	.700	.45	.058	.06	.034	-	-	5.44	19 05
" "	" V.,	-	8.83	.606	.295	.036	.034	.026	.018	.048	4.62	16 09

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Fertilizing Ingredients in Hominy Feed.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Hominy Feed,	Report I.,	8.93	1.89	.98	.18	.49	.28	-	-	-	1.63	$6 14

Fertilizing Ingredients in Wheat (Wheat Meal).

Wheat Meal,	Report IV.,	9.83	1.22	.57	.17	.54	.05	1.06	-	-	2.21	$8 65

Fertilizing Ingredients in Wheat Bran.

Wheat Bran,	Report III.,	-	-	2.46	.26	1.95	.89	.37	-	.14	2.86	$14 91
" "	" IV.,	11.45	-	3.05	-	1.49	.90	.09	-	.11	2.82	14 52
" "	" IV.,	9.40	-	3.12	-	1.42	.91	.10	-	.15	3.03	15 42
" "	" V.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Rye Middlings,	Report V.,	12.54	3.52	1.26	.09	.81	.32	.03	.02	.17	1.84	$8 46

Fertilizing Ingredients of Various Fodder Stuffs.

Linseed Cake,	Report I.,	8.35	6.89	1.86	0.64	1.43	0.77	–	–	–	5.462	$22 01
Cocoa Dust,	" I.,	7.10	6.35	1.34	0.63	2.11	Traces.	–	–	–	2.299	11 22
Pea Meal,	" V.,	8.85	–	0.82	0.302	0.993	0.302	0.618	0.027	0.122	3.08	11 31
Broom Corn Waste, stalks,	" V.,	10.37	4.70	0.460	0.242	1.858	0.170	–	–	1.000	0.87	5 09

Fertilizing Ingredients of Cotton-seed Meal.

VARIETY.	Source of Analysis.	Moisture.	Organic and Volatile Matter.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Cotton-seed Meal, coarse portion,	Report I.,	7.09	93.465	6.535	2.341	2.63	1.797	2.23	–	1.784	5.90	$24 40
" " " " "	" III.,	6.80	94.230	5.77	1.45	0.39	0.89	0.99	–	0.600	6.10	24 46
" " " (damaged),	" IV.,	9.90	–	–	1.26	0.22	1.21	0.56	–	0.200	3.73	14 97
" " "	" V.,	7.71	92.71	7.29	2.01	0.27	2.09	1.13	–	0.06	4.02	17 86

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Fertilizing Ingredients in Various Grasses and Leguminous Plants.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Hay from Station, 1887,	Report V.,	10.78	6.34	.464	.521	2.035	.284	.064	.032	1.37	1.25	$6 58
Rowen from Station, 1887,	" V.,	8.84	9.57	.364	.853	2.800	.197	.122	.057	2.18	1.93	9 50
Herd's Grass, fertilized, collected in bloom,	Bulletin 24,	7.80	4.88	.36	.44	1.63	.12	.08	–	1.01	1.21	5 93
Same, unfertilized,	" 26,	7.24	4.93	.56	.99	1.44	.09	.37	–	1.33	1.31	6 35
Redtop, fertilized, collected July 22,	Report V.,	8.24	4.44	3.52	.451	1.160	.149	.820	.038	1.710	.94	4 61
" unfertilized, collected July 22,	" V.,	8.02	3 84	3.26	.575	.059	.111	.317	.060	1.836	1.21	5 07
" collected July 5, fertilized,	" V.,	6.81	5.30	.377	.614	1.206	.125	.180	.024	1.716	1 19	5 53
" collected July 5, unfertilized,	" V.,	7.75	4.77	.391	.645	1.054	.149	.425	.083	1.683	1.24	5 59
Orchard Grass, in bloom, unfertilized,	" V.,	9.16	7.88	.399	.457	2.114	.236	.233	.021	1.976	1.64	7 86
" " in bloom, fertilized,	" V.,	9.09	7.18	.483	.401	2.339	.255	.211	.014	1.867	1.30	6 99

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Serradella, in bloom (Hay),	Bulletin 24,	Hay,	10.54	10.60	0.90	2.63	0.260	.39	0.55	–	0.21	2.54	11 93
Serradella, collected Sept. 20 (Green),	Report V.,		80.58	–	0.124	0.472	0.398	.067	0.098	.021	0 157	0.385	1 80
White Lupine, in bloom,	"	III.,	85.35	0.74	0.35	3.07	1.73	.73	0.08	.17	0.90	0.44	3 39
Horse Bean, whole plant, collected in bloom,	"	III.,	74.71	–	0.33	1.37	1.37	.62	0.09	.20	2.04	0.675	3 87
Alsyke Clover, unfertilized, collected Aug. 16,	"	V.,	8.30	12.24	0.584	1.836	1.605	.610	0.570	.246	3.241	2.54	10 70
Alsyke Clover, fertilized, collected Aug. 16,	"	V.,	8.64	9.98	1.016	1.644	2.740	.735	0.236	.417	3.226	2.19	11 00
Luzerne (Alfalfa), unfertilized, collected Aug. 26,	"	V.,	8.41	7.17	0.458	2.558	0.872	.582	1.354	.085	0.687	1.90	7 65
Luzerne (Alfalfa), fertilized, collected Aug. 26,	"	V.,	8.33	6.58	0.444	1.486	2.043	.249	0 668	.105	0.716	1.63	7 81

Fertilizing Ingredients in Roots and Fruits.

Vilmorin Sugar Beet,	Report IV.,		85.99	.62	.03	.06	.18	.04	.18	.01	.10	.29	$1 18
Carrots,	Bulletin 26,		90.02	–	.10	.07	.54	.02	.11	.01	.01	.14	1 06
R. I. Greening Apples,	Report IV.,		84.65	.327	.008	.023	.122	.025	.013	.001	.002	.113	0 49
Sweet Apples,	"	IV.,	75.17	.501	.011	.044	.269	.029	.042	.005	.004	.156	0 60
Apple Pomace, Baldwin,	"	IV.,	82.78	.306	.018	.032	.150	.028	.020	.008	.008	.213	0 87
" " R. I. Greening,	"	IV.,	78.22	.237	.017	.042	.119	.027	.032	.008	.009	.241	0 92

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Compilation of Analyses made at A of Agricultural Chemicals and Re used for Fertilizing Purposes.*

As the basis of Valuation changes from year to year, n

1868 to 1888.

Muriate of Potash (43 Analys

	Per Cent.		
	Highest.	Lowest.	Averag
Moisture at 100° C.,	4.05	0.05	2.0
Potassium oxide,	58.98	45.94	52.4
Sodium oxide,	11.26	2.13	6.6
Magnesium oxide,	0.90	0.30	0.5
Chlorine,	54.00	43.20	48.6
Insoluble matter,	2.00	0.15	0.7

Sulphate of Potash (14 Analys

Moisture at 100° C.,	5.00	0.19	1.0
Potassium oxide,	51.28	20.44	35.8
Sodium oxide,	8.59	0.34	4.4
Magnesium oxide,	2.63	0.24	1.5
Sulphuric acid,	59.30	10.86	45.0
Insoluble matter,	31.55	0.14	0.7

* This compilation does not include the analyses made They are to be found in the Reports of the State Inspector o to 1888, contained in the Reports of the Secretary of the Mas of Agriculture for those years.

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Sulphate of Potash and Magnesia (12 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
isture at 100° C., . .	11.58	1.95	5.50	
tassium oxide, . .	27.77	11.70	22.50	
dium oxide, . . .	18.97	2.09	6.50	
gnesium oxide, . .	13.66	10.86	12.25	
lcium oxide, . .	3.38	0.82	2.50	
lphuric acid, . .	47.90	31.91	43.00	
lorine, ...	7.80	0.14	2.50	
soluble matter, . .	2.36	0.26	1.41	

German Potash Salts (11 Analyses).

isture at 100° C., . .	25.83	.45	13.14	
tassium oxide, . .	50.40	7.56	21.63	
dium oxide, . . .	26.23	1.30	13.76	
lcium oxide, . .	1.26	0.06	.85	
gnesium oxide, . .	9.83	Trace.	9.25	
lphuric acid, . .	21.53	.17	10.85	
lorine, ...	49.11	22.27	35.63	
soluble matter, . .	3.76	.90	2.08	

Kainite (3 Analyses).

isture at 100° C., . .	13.57	2.15	9.26	
tassium oxide, . .	16.48	12.51	14.04	
dium oxide, . . .	–	–	*21.38	* The only estimation made.
lcium oxide, . . .	1.41	.82	1.12	
gnesium oxide, . .	11.30	6.65	8.97	
lphuric acid, . .	23.71	17.53	21.05	
lorine, ...	–	–	*32.38	* The only estimation made.
soluble matter, . .	1.56	.17	.86	

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Carnallite (1 Analysis).

Potassium oxide,	
Sodium oxide,	
Magnesium oxide,	
Sulphuric acid,	
Chlorine,	

Krugite (1 Analysis).

Moisture at 100° C.,	
Calcium oxide,	
Magnesium oxide,	
Potassium oxide,	
Sodium oxide,	
Sulphuric acid,	
Chlorine,	
Insoluble matter,	

Sulphate of Magnesia (9 Analys

	Per Cent.		
	Highest.	Lowest.	Average
Moisture at 100° C.,	31.90	7.50	22.50
Calcium oxide,	3.89	1.15	2.52
Magnesium oxide,	*25.29	13.50	18.25
Sulphuric acid,	*52.23	31.91	37.00
Insoluble matter,	11.06	.40	5.73

Nova Scotia Plaster (9 Analys

Moisture at 100° C.,	15.79	.52	6.50
Calcium oxide,	37.59	30.60	33.50
Magnesium oxide,	1.40	.36	.75
Sulphuric acid,	54.10	33.56	44.00
Carbonic acid,	–	–	–
Insoluble matter,	7.95	.45	2.00

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Onondaga Plaster (7 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C., .	22.25	8.95	13.27	
lcium oxide, . . .	31.46	29.15	30.00	Contains 1 sample of Cayuga Plaster.
agnesium oxide, . .	6.06	3.89	4.66	
lphuric acid, . .	36.00	31.58	33.00	
rbonic acid, . . .	8.80	7.20	8.20	
soluble matter, . .	12.00	8.28	9.83	

Gypseous Shale (1 Analysis).

	Per cent.
lcium sulphate, ...	38.55
lcium carbonate, ...	11.05
agnesium carbonate, ...	2.65
soluble matter, ...	37.15

Gas-house Lime (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C., .	33.55	11.01	22.28	
lcium oxide, . . .	45.80	40.00	42.66	
gnesium oxide, . .	8.30	8.30	8.30	
lphuric acid, . .	20.73	20.73	20.73	Sulphuric acid includes all forms of sulphur present.
oluble matter, . .	15.00	0.40	6.05	

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Lime Waste.

	Per Cent.		
	Liquid from Lime-vats (Evaporated).	Mass from bottom of Lime-vats.	Lime Waste from Sugar Factory.
Moisture at 100° C.,	11.50	17.54	36.30
Ash,	41.00	65.24	–
Calcium oxide,	23.40	47.80	27.51
Magnesium oxide,	–	–	Trace.
Potassium oxide,	–	-	.22
Phosphoric acid,	.77	.81	2.25
Nitrogen,	6.87	1.06	–
Insoluble matter,	.10	5.50	.32

Lime-kiln Ashes (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	30.70	.20	15.45
Calcium oxide,	50.16	36.00	43.08
Magnesium oxide,	4.45	1.26	2.60
Potassium oxide,	1.70	.02	.86
Phosphoric acid,	3.16	Trace.	1.18
Carbonic acid,	39.36	9.66	16.66
Insoluble matter,	53.77	3.30	14.54

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Marls (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C., . .	55.80	0.60	18.18	
lcium oxide, . . .	50.61	20.72	40.07	
agnesium oxide, . .	1.03	0.22	0.64	Massachusetts.
on and alumina, . .	1.00	0.36	0.69	
osphoric acid, . .	2.72	0.07	1.05	
rbonic acid, . . .	40.38	16.63	28.51	
soluble matter, . .	3.44	3.44	3.44	

Virginia Marl.

	Per Cent.		Remarks.
	2 feet below Surface.	4 feet below Surface.	
oisture at 100° C., . .	16.70	15.26	
lcium oxide, . . .	9.21	5.29	No. 1 contained a large amount of shells.
agnesium oxide, . . .	0.25	0.16	
tassium oxide, . . .	0.61	0.37	
osphoric acid, . . .	0.09	0.08	No. 2 was largely sand.
lphuric acid, . . .	1.00	0.31	
rbonic acid, ...	4.23	1.76	
soluble matter, . . .	59.59	68.86	

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Wood Ashes. (Canada.) (71 A

	Per Cent.		
	Highest.	Lowest.	Averag
Moisture at 100° C., . .	28.57	0.70	12.0
Calcium oxide,. . .	50.89	18.00	34.4
Magnesium oxide, . .	7.47	2.28	3.5
Iron oxide, . . .	–	–	0.8
Potassium oxide, . .	8.51	2.49	5.5
Phosphoric acid, . .	3.34	0.29	1.8
Insoluble matter, . .	24.10	2.10	12.5

Cotton-seed Hull Ashes (16 Anal

Moisture at 100° C., . .	26.81	2.30	7.3
Calcium oxide,. . .	39.75	3.35	10.0
Magnesium oxide, . .	17.15	2.02	9.5
Iron oxide, . . .	–	–	1.5
Potassium oxide, . .	42.12	5.00	20.9
Phosphoric acid, . .	13.67	0.76	7.5
Insoluble matter, . .	32.48	5.38	11.7

Ashes of Spent Tan-bark (3 Anal

Moisture at 100° C., . .	7.45	4.87	6.3
Calcium oxide,. . .	37.26	31.35	33.4
Magnesium oxide, . .	5.10	2.57	3.5
Potassium oxide, . .	2.87	1.14	2.0
Phosphoric acid, . .	2.77	0.13	1.6
Insoluble matter, . .	24.33	24.33	24.3

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Ashes of Waste Products.

	Per Cent.			Remarks.
	Chestnut R. R. Ties.	Logwood.	Mill.	
loisture at 100° C.,	6.15	1.50	0.53	
alcium oxide,	4.71	3.90	34.93	
lagnesium oxide,	1.80	Trace.	1.35	
otassium oxide,	0.19	0.08	1.60	
hosphoric acid,	1.54	2.30	0.46	
nsoluble matter,	77.83	9.70	36.36	

Hard Pine Wood Ashes.

	Per cent.
loisture at 100° C.,	0.75
alcium oxide,	24.95
agnesium oxide,	8.39
otassium oxide,	10.16
hosphoric acid,	2 24
soluble matter,	29.90

Nitrate of Potash (1 Analysis).

	Per cent.
oisture at 100° C.,	1.75
otassium oxide,	45.62
itrogen,	14.58
soluble matter,	Trace.

Nitrate of Soda (12 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C.,	2.00	0.85	1.25	
odium oxide,	70.97	35.00	35.50	
lcium oxide,	0.41	Trace.	Trace.	
agnesium oxide,	0.04	Trace.	Trace.	
trogen,	16.26	14.44	15.75	
lphuric acid,	0.20	Trace.	Trace.	
lorine,	2 52	0.20	0.50	
soluble matter,	0.90	0.24	0.50	

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Saltpetre Waste from Gunpowder Works

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.24	0.50	2.75
Potassium oxide,	30.94	4.65	18.00
Sodium oxide,	45.92	22.08	34.00
Calcium oxide,	*0.83	*0.71	0.75
Magnesium oxide,	*0.28	*0.09	0.19
Nitrogen,	3.30	0.80	2.42
Sulphuric acid,	*4.85	*0.84	2.85
Chlorine,	56.00	37.66	48.30
Insoluble matter,	†	–	–
Nitre Salt-cake (2 Analyses)			
Moisture at 100° C.,	6.71	5.34	6.03
Potassium oxide,	0.87	Trace.	0.87
Sodium oxide,	32.72	26.40	29.56
Nitrogen,	2.29	–	2.29
Sulphuric acid,	48.85	46.69	47.77
Insoluble matter,	4.12	3.73	3.92
Sulphate of Ammonia (21 Analy			
Moisture at 100° C.,	2.40	0.13	1.00
Nitrogen,	22.23	19.70	20.50
Sulphuric acid,	70.70	57.68	60.00
Insoluble matter,	–	–	Trace.

Ammonite.

Moisture at 100° C.,
Phosphoric acid,
Nitrogen,
Insoluble matter,

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Dried Blood (11 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
isture at 100° C., . .	21.52	7.65	12.50	
n, ...	10.04	3.56	6.37	
osphoric acid, . .	6.23	1.53	1.91	
rogen, ...	13.55	7.80	10.52	

Refuse Materials (Animal).

	Per Cent.			Remarks.
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.	
isture at 100° C., . .	8.54	39.24	7.25	
n, ...	14.42	33.53	–	
cium oxide, . . .	–	–	3.94	
gnesium oxide, . .	–	–	1.27	
osphoric acid, . .	0.88	–	3.19	
rogen, ...	12.12	5.26	2.43	
oluble matter, . .	0.96	8.44	39.05	

Horn and Hoof Waste (3 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
isture at 100° C., . .	10.27	10.08	10.17	
n, ...	14.62	1.05	7.63	
osphoric acid, . .	2.30	2.30	2.30	
rogen, ...	16.10	11.84	14.47	
oluble matter, . .	0.24	0.24	0.24	

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Wool Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., . .	10.12	8.43	9.27
Nitrogen, ...	*6.25	5.00	5.62

Raw Wool and Wool Washin

	Per Cent.		
	Raw Wool.	Water Washings.	Acid Washings
Moisture at 100° C., . .	6.95	–	–
Ash, ...	7.54	–	–
Fat, ...	3.92	–	–
Calcium oxide, . . .	–	0 28	0.61
Magnesium oxide, . .	–	None.	0.20
Potassium oxide, . .	–	3.92	4.20
Sodium oxide, . . .	–	0.49	0.40
Nitrogen, ...	12.88	–	–
Insoluble matter, . .	3.63	–	–

Meat Mass (6 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., .	18.75	8.16	12.09
Ash, ...	14.66	2.90	13.60
Total phosphoric acid, .	3.58	0.56	2.07
Nitrogen, ...	11.50	9.69	10.44
Insoluble matter, . .	0.77	0.40	0.58

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Refuse from Rendering Establishments.

	Per Cent.				
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap-Grease Refuse.
loisture at 100° C., .	82.92	14.80	10.80	92.14	38.79
sh, ...	7.07	8.40	7.50	–	43.13
hosphoric acid, . .	1.26	0.53	0.46	0.14	11.04
itrogen, ...	1.14	9.97	14.47	1.12	2.21
soluble matter, . .	–	0.64	0.26	–	1.20

Bones (95 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
loisture at 100° C., . .	11.90	3.05	7.47	
sh, ...	74.90	37.25	56.07	
otal phosphoric acid, .	29.83	12.06	22.50	
oluble phosphoric acid, .	0.76	0.10	0.43	
everted phosphoric acid,	16.78	2.24	6.50	
soluble phosphoric acid,	23.37	8.13	15.70	
itrogen, ...	6.75	1.50	4.12	
soluble matter, . .	6.00	0.04	2.00	

Tankage (12 Analyses).

loisture at 100 C., . .	28.09	5 46	14.61	
sh, ...	37.06	19.40	23.23	
otal phosphoric acid, .	14.60	8.00	10.67	
oluble phosphoric acid, .	0.27	0.27	0.27	
everted phosphoric acid,	3.25	3.25	3.25	
soluble phosphoric acid,	8.79	8.79	8.79	
itrogen, ...	8.07	5.82	7.08	
soluble matter, . .	2.00	0.56	1.23	

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Fish containing 20 per cent. or less of
Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	19.88	6.61	13.24
Ash,	72.23	15.99	20.00
Total phosphoric acid,	16.64	4.33	8.25
Soluble phosphoric acid,	1.70	.37	.55
Reverted phosphoric acid,	4.57	1.78	2.17
Insoluble phosphoric acid,	7.16	2.11	3.80
Potassium oxide,	.45	.45	.45
Nitrogen,	10.24	3.87	7.05
Insoluble matter,	4.99	.74	2.50

Fish containing between 20 per cent. and
Moisture (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	38.11	20.58	29.34
Ash,	36.50	16.87	24.14
Total phosphoric acid,	8.90	5.60	7.25
Soluble phosphoric acid,	*.82	.82	.82
Reverted phosphoric acid,	*2.87	2.87	2.87
Insoluble phosphoric acid,	*3.99	3.99	3.99
Potassium oxide,	†0.85	0.85	0.85
Nitrogen,	7.41	4.22	5.81
Insoluble matter,	2.89	0.82	1.85

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sh containing 40 per cent. and more of Moisture (10 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
isture at 100 C., . .	50.58	40.35	45.46	
, ...	20.78	1.92*	12.50	* Fish-liver refuse.
al phosphoric acid, .	8.56	1.02*	5.08	
uble phosphoric acid, ,	1.51	0.83	1.17	
erted phosphoric acid,	2.02	0.64	1.33	
oluble phosphoric acid,	3.62	1.88	2.75	
assium oxide, . .	–	–	–	
rogen, ...	7.60	2.43	4.97	
oluble matter, . .	2.44	0.16	1.35	

Whale Flesh.

	Per Cent.			Remarks.
	Raw.	Dry (with Fat).	Dry (without Fat).	
sture at 100° C., . .	44.50	–	–	
. . . . .	1.04	1.86	3.20	
. . . . .	22.81	40.70	–	
h, ...	32.10	57.44	96.80	
ogen, ...	4.86	8.68	14.60	

Lobster Shells.

	Per cent.
ture at 100° C., ...	7.27
ium oxide, ...	22.24
nesium oxide, ...	1.30
phoric acid, ...	3.52
ogen, ...	4.50
uble matter, ...	0.27

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Peruvian Guano (26 Analyse

	Per Cent.		
	Highest.	Lowest.	Average
Moisture at 100° C.,	22.61	7.02	14.8
Ash,	61.65	13.58	37.6
Total phosphoric acid,	23.10	3.43	13.2
Soluble phosphoric acid,	8.80	0.35	4.5
Reverted phosphoric acid,	6.20	1.38	3.7
Insoluble phosphoric acid,	16.50	4.67	10.5
Potassium oxide,	4.08	1.14	2.61
Nitrogen,	11.26	4.44	7.8
Insoluble matter,	11.91	1.30	6.6
Bat Guano (9 Analyses).			
Moisture at 100° C.,	72.38	7.80	40.0
Ash,	72.14	4.34	38.2
Phosphoric acid,	6.53	1.00	3.7
Nitrogen as nitrates,	1.80	0.24	1.0
Nitrogen as ammoniates,	3.42	1.49	2.4
Nitrogen in organic matter,	5.66	0.34	3.0
Insoluble matter,	54.15	0.20	2.0
Cuba Guano (5 Analyses).			
Moisture at 100° C.,	36.85	12.10	24.27
Potassium oxide,	1.20	0.14	0.67
Phosphoric acid,	24.35	11.54	17.9
Nitrogen as nitrates,	1.00	0.24	0.6
Nitrogen as ammoniates,	0.26	0.14	0.2
Nitrogen in organic matter,	1.48	0.23	0.8
Insoluble matter,	3.40	2.95	3.1

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Caribbean Guano (Orchilla) (10 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C.,	12.50	2.12	7.31	
alcium oxide,	45.00	34.91	39.95	
agnesium oxide,	4.13	2.46	3.29	
osphoric acid,	35.43	18.11	26.77	
lphuric acid,	2.36	1.80	2.08	
soluble matter,	2.40	0.17	1.27	

South American Bone Ash.

	Per cent.
oisture at 100° C.,	7.00
alcium oxide,	44.89
osphoric acid,	35.89
soluble matter,	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
oisture at 100° C.,	1.90	0.10	1.50	
alcium oxide,	–	–	*41.87	* Only estimate.
agnesium oxide,	–	–	*3.03	
on and alumina oxide,	–	–	*4.26	
otal phosphoric acid,	30.51	25.81	28.03	
luble phosphoric acid,	–	–	*0.27	* Only estimate.
verted phosphoric acid,	0.47	0.19	0.33	
soluble phosphoric acid,	30.31	25.07	27.69	
soluble matter,	13.74	9.18	11.61	

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Navassa Phosphate (2 Analyses

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., . .	–	–	*5.60
Calcium oxide,. . .	37.67	37.22	37.44
Iron oxide, . . .	11.79	8.75	10.27
Alumina oxide, . .	–	–	*4.24
Phosphoric acid, . .	34.45	34.09	34.27
Insoluble matter, . .	–	–	*2.70

Brockville Phosphate (1 Analysi

Moisture at 100° C., ...
Phosphoric acid, ...
Insoluble matter, ...

Bone-black (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., . .	10.65	1.55	4.60
Phosphoric acid, . .	30.54	23.47	28.28
Insoluble matter, . .	6.60	1.53	3.64

Phosphatic Slags.

	Per Cent.	
	I.	II.
Moisture at 100° C., ...	0.10	0.37
Calcium oxide, ...	41.87	49.82
Magnesium oxide, ...	3.03	–
Iron and alumina oxides, . .	4.26	–
Total phosphoric acid, . . .	30.51	18.91
Soluble phosphoric acid, . .	–	–
Reverted phosphoric acid, . .	0.19	5.93
Insoluble phosphoric acid, . .	30.32	12.98
Insoluble matter, ...	13.74	5.06

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Castor Bean Pomace (3 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	10.18	9.25	9.98	
Calcium oxide, . .	0.96	0.77	0.87	
Magnesium oxide, . .	0.37	0.20	0.29	
Potassium oxide, . .	1.70	0.64	1.12	
Phosphoric acid, . .	2.22	2.03	2.16	
Nitrogen, ...	5.69	5.33	5.56	
Insoluble matter, . .	2.38	1.12	1.75	

Cotton Refuse.

	Per Cent.			Remarks.
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	
Moisture at 100° C., . .	34.46	5.53	34.69	
Ash, ...	50.93	–	–	
Calcium oxide, . . .	0.90	1.45	2.45	
Magnesium oxide, . .	0.90	0.87	1.13	
Potassium oxide, . .	0.19	0.89	0.80	
Phosphoric acid, . .	0.21	0.84	1.54	
Nitrogen, ...	0.50	1.32	1.30	
Insoluble matter, . .	47.46	49.68	41.33	

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Cotton-seed Meal (5 Analyses

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.80	9.90
Ash,	5.77	–
Calcium oxide,	0.39	0.22
Magnesium oxide,	0.99	0.56
Potassium oxide,	0.89	1.21
Phosphoric acid,	1.45	1.26
Nitrogen,	6.10	3.73
Insoluble matter,	0.60	0.20

Rotten Brewer's Grain.

Moisture at 100° C.,
Calcium oxide,
Magnesium oxide,
Potassium oxide,
Phosphoric acid,
Nitrogen,
Insoluble matter,

Tobacco Stems (5 Analyses)

	Per Cent.		
	Highest.	Lowest.	Average
Moisture at 100° C.,	12.18	8.95	10.61
Ash,	15.00	13.30	14.07
Calcium oxide,	4.76	3.39	3.89
Magnesium oxide,	1.40	1.11	1.23
Potassium oxide,	8.82	3.34	6.44
Sodium oxide,	0.68	0.16	0.34
Phosphoric acid,	0.87	0.44	0.60
Nitrogen,	2.69	0.90	2.29
Insoluble matter,	1.35	0.29	0.82

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Refuse Materials (Vegetable).

	Per Cent.			Remarks.
	Glucose Refuse.	Hop Refuse.	Sumac Waste.	
isture at 100 C., . .	8.10	80.98	63.06	
h, ...	–	–	6.80	*Potassium oxide.*
lcium oxide, . . .	0.18	0.27	1.14	I. .15 per cent.
gnesium oxide, . .	0.02	0.10	3.25	II. .11 per cent.
osphoric acid, . .	0.29	0.20	–	III. .17 per cent.
trogen, ...	2.62	0.98	1.19	
oluble matter, . .	0.07	0.63	2.25	

Sea-weeds.

	Per Cent.					Remarks.
	Eel-Grass.		Rockweed.		Wet Kelp.	
	I.	II.	Green.	Dry.		
isture at 100° C., .	45.61	25.17	68.50	10.68	88.04	
h, ...	20.39	10.81	23.70	55.75	2.26	
lcium oxide, . .	1.56	2.70	–	7.66	–	
gnesium oxide, .	0.09	0.12	–	0.21	–	
tassium oxide, . .	1.61	0.21	–	4.89	–	
lium oxide, . .	2.51	0.74	–	7.90	–	
osphoric acid, . .	0.41	0.22	–	2.75	–	
rogen, ...	0.70	0.96	0.62	1.45	0.26	
oluble matter, . .	0.46	1.66	–	10.40	–	

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Sea-weed Ashes.

Moisture at 100° C.,	
Calcium oxide,	
Magnesium oxide,	
Potassium oxide,	
Sodium oxide,	
Phosphoric acid,	
Sulphuric acid,	
Sulphur,	
Chlorine,	
Magnesium chloride,	
Insoluble matter,	

Rockweed.

[I. Collected in May. II. Collected in Dec

Fresh wet rockweed lost, in air, of water,	
Fresh wet rockweed lost, at 100° C., of water,	
Air-dried rockweed contained, of vegetable matter,	
Air-dried rockweed contained, of water,	
The filled pods left, at 100° C., of solid organic matter	
The fresh stems left, at 100° C., of solid organic matter,	
The slime of the pods, dried at 100° C., contained, of nitrogen,	
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	
Rockweed, air-dried, contained, of nitrogen,	
" fresh (wet), contained, of nitrogen,	
" dried at 100° C., contained, ashes,	
" air-dried, contained, ashes,	
" fresh (wet), contained, ashes,	
The slime of the pods contained, ashes,	

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One hundred parts of the ash contained (I.) : —

	Per cent.
otassium oxide,	4.842
odium oxide,	12.050
alcium oxide,	2.691
agnesium oxide,	2.753
erric oxide,	.338
ulphuric acid,	7.986
hosphoric acid,	6.240

Mud.

	Per Cent.						Remarks.
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.	
oisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37	
sh,	27.29	72.02	49.28	33.09	39.60	–	
alcium oxide,	0.93	23.39	0.90	0.91	0.91	1.27	
agnesium oxide,	0.14	–	0.31	0.43	0.66	0.29	
otassium oxide,	6.17	–	0.33	0.32	0.38	0.22	
odium oxide,	0.70	–	0.94	0.94	0.86	–	
erric oxide,	3.48	8.26	4.55	3.70	4.26	1.80	
hosphoric acid,	0.10	0.35	Trace.	Trace.	Trace.	0.26	
itrogen,	0.21	0.72	0.39	0.40	1.64	1.37	
soluble matter,	–	37.60	43.55	26.20	31.84	18.26	

Soil from a Diked Marsh.

	Per cent.
oisture at 100° C.,	33.40
sh,	7.85
alcium oxide,	1.24
otassium oxide,	.26
hosphoric acid,	.13
itrogen,	1.64
soluble matter,	3.65

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Muck (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., . .	89.89	12.03	55.13
Ash, ...	26.12	3.05	13.75
Nitrogen, ...	1.47	0.26	0.91

Peat (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C., .	85.38	*11.29	61.50
Ash, ...	33.72	1.20	7.71
Calcium oxide, . .	0.50	0.50	0.50
Nitrogen, ...	1.40	0.41	0.71
Insoluble matter, . .	0.38	0.38	0.38

Turf (2 Analyses).

	Per Cent.	
	I.	II.
Moisture at 100 C., ...	25.58	13.00
Ash, ...	3.28	9.43
Nitrogen, ...	1.91	1.97

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Hen Manure.

	Per Cent.		Remarks.
	Dried.	Fresh.	
oisture at 100 C.,	8.35	45.73	
lcium oxide,	2.22	0.97	
agnesium oxide,	0.62	–	
tassium oxide,	9.94	0.18	
osphoric acid,	2.02	0.47	
trogen in organic matter,	1.85	0.79	
trogen as ammoniates,	0.28		
soluble matter,	34.65	39.32	

Poudrette.

	Per cent.
oisture at 100° C.,	5.25
h,	35.45
tassium oxide,	0.49
osphoric acid,	5.74
trogen,	3.58
soluble matter,	4.65

Miscellaneous.

	Per Cent.	
	Soot.	Ashes from Blue Works.
oisture at 100 C.,	5.54	12.74
rganic and volatile matter,	22.90	36.22
agnesium oxide,	–	Trace.
tassium oxide,	1.83	9.02
anogen compounds,	–	Trace.
soluble matter,	35.34	12.30

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METEOROLOGY.

The past year's meteorological observatio
continuation of those of the two previous se
the same general plan as recommended to
servers of the U. S. Signal Service, and d
Third Annual Report. As soon as possible
of each month, a copy of our monthly reco
tions is forwarded to the chief signal officer
D. C., and also to the officer stationed at Bo
summary of each month's observations are p
bulletins and annual reports, and are thus
to the farmers throughout the State.

January opened with 3.50 inches of snow,
ing. Between the 5th and 17th, 29 inches o
during the thaw of the last eight days the
disappeared, and at the end of the month on
and there was to be seen. The mean tem
month was 3.9° below that of any month of
last fifty years. Storms were frequent, and
snow fell during February. During the e
18 there was a sharp shower, accompanied
lightning, and at 8 P. M. a slight earthquake
Bluebirds were seen on the 13th, and robins
March. The temperature for the month of
than for any previous April since 1875, a
there was a fall of 6.50 inches of snow. On
frost occurred; the last, on May 14. Abun
ure characterized the growing months —
August. The total rainfall for June was 5
July, 8.93 inches; and for August, 7.75 inc

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perature for July (73.70°) was the highest for the same nth since 1839, when it was 74.40°; July, 1863, it was 87°, the nearest approach to it. Similar relations are e of the total rainfall. During the month there fell 8.93 nes, the largest amount during any month of July since 9, when it was 9.56 inches; in 1863 it was 8.63 inches, next highest amount. Between 4.30 P. M. on the 23d of y, and 6 A. M. on the 24th, 3.50 inches of rain fell; and n 1 P. M. on the 24th, to 4.25 P. M. of the same day, 1.50 nes fell, making a total rainfall of 5.00 inches inside of hours. It was the heaviest rainfall of the season, and did rge amount of damage, not only to the growing crops, by the washing of roads and hillsides. Very heavy fogs racterized both August and September. The first frost urred on the 17th of September. Nov. 11 there were eral snow-squalls during the day, but the first snow of the on of any amount was on the 18th of December. The r closes with about four inches of snow, and good sleigh-

During the summer there have been sixteen thunder-ms, some of which were very severe, and did considera-damage. The first occurred on the 18th of February, and last on the 2d of October. During those storms which urred in the months of July and August, observations e taken every half-hour, and forwarded to the signal ser- officer at Boston, Mass.

Weekly crop reports were forwarded during the months uly, August and September, to the Boston Signal Service ion, giving the rainfall, temperature, amount of sunshine, the condition of the different crops. Farmers had good ther for securing their hay crop, but, on account of the essive moisture of July and August, they were seriously lered with their rowen, some of it being spoiled before pportunity came to secure it. Potatoes suffered from continued wet spell, but a good crop of corn was ob-ed. The open fall was favorable for farm work.

he prevailing direction of the wind for the year was V. It was northwest in January, February, March, il, August, September, October, November and Decem-; southwest in May and June, and south in July.

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The number of days when the sky w
tenths covered by clouds ("clear" days),
the greatest number, twelve, being in May
two, in October.

There were ninety-five "cloudy" days,
sky was more than seven-tenths covered
cember had the greatest number, sixteen;
May had the fewest, four each.

Of the remaining 199 days, only two c
"fair" days, that is, between four-tenths
cloudy; the others were variable, being f
portion, and clear or fair another.

The highest temperature of the year wa
on July 2; the lowest was on the 19th of
The maximum is 2° lower than that of la
which was 95° on the 6th of July; whil
practically the same, last year (1886) bei
13th and 14th of January. The absolute
ture for 1887 is 115.2°; 1.8° lower than t
of 1886.

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Summary of Meteorological Observations, 1887.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January,	15.7	23.5	19.2	19.4	28.6	7.6	21.0	47.2	24th	—22.2	19th	-	-	-	-	4.57	29th
February,	20.3	27.8	24.3	24.2	32.1	15.7	16.4	43.8	9th	—3.8	5th	-	-	-	-	5.05	26th to 27th
March,	22.0	33.0	27.2	26.4	33.6	17.1	16.5	46.0	21st	—2.4	5th	-	-	-	-	4.05	5th to 6th
April,	36.3	49.1	40.6	41.6	51.6	30.4	21.2	74.4	10th	17.1	8th	-	-	-	-	2.97½	28th to 29th
May,	54.5	70.8	58.6	60.9	73.1	47 3	25.8	86.5	20th	33.2	14th	83.0	54.4	72.9	70.7	1.13	28th
June,	60.7	73 9	66.0	65.7	76.0	53.4	22 6	91.0	30th	38 5	11th	85 0	58.5	82.2	76.4	5.09	22d to 24th
July,	70.0	81.5	71.7	73.7	83.7	64.0	19.7	93 6	2d	56.0	15th	89.7	64.9	85.6	80.1	8.93	23d to 24th
August,	54.4	73.4	63.0	64.9	75 4	54.1	21.3	88.0	1st	42.5	14th, 28th	92.1	66.8	84.9	81.2	7.75	18th
September,	50.1	65.5	54.4	55.9	67.1	45.0	22.1	80.0	7th	29.5	27th	90.3	63.8	87.4	80.5	1.22	7th
October,	41.1	56.0	46.3	47.0	58.8	36.6	22.2	74.4	8th	17.0	30th	88.9	55.9	79.4	74.7	2.10	21st
November,	32 0	43.5	35.1	36 5	45.7	26 8	18.9	64.8	7th	11.0	30th	-	-	-	-	3.35	15th
December,	26.7	31.5	25.8	26.6	34.0	17.3	16.7	51.0	12th	—6 0	31st	-	-	-	-	4.11	28th
Sums and Means,	40.31	52.45	44.35	45.2	54.97	34.60	20.36	70 05	-	17.53	-	88.16	60.72	82 06	77.26	50.33	-

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Miscellaneous Phenomena. — Date

	Frost.	Snow.	Rain.	Thunder storms.
January, . .	4.	5, 6, 9, 10, 13, 14, 15, 17, 19, 23, 24, 26, 30, 31.	1, 23, 24, 29, 30, 31.	–
February, .	–	2, 3, 6, 7, 8, 9, 14, 15, 18, 22, 24, 26, 27.	8, 10, 11, 14, 15, 18, 24.	18.
March, . .	–	5, 14, 15, 17, 22.	6, 9, 10, 18, 19, 22, 28, 29.	–
April, . .	8, 9, 15, 21.	18.	5, 16, 23, 25, 26, 28, 29.	29.
May, . .	14.	–	6, 25, 26, 28.	6, 25, 27
June, . .	–	–	1, 2, 4, 17, 21, 22, 24.	22, 23.
July, . .	–	–	5, 6, 10, 16, 17, 18, 21, 23, 24, 26, 29.	23, 24, 29.
August, . .	–	–	1, 2, 3, 11, 18, 20, 22, 23, 24, 28, 30.	11, 18, 20, 24.
September, .	17, 18, 27.	–	7, 12, 22, 29, 30.	7.
October, . .	12, 14, 15, 16, 17, 20, 23, 26, 29.	–	1, 2, 4, 11, 21.	2.
November, .	2, 3-5, 6, 9, 10, 11, 18, 19, 22, 29.	11.	10, 11, 15, 19, 20, 23, 25, 26, 28.	–
December, .	1, 2, 4, 6, 7, 9, 14.	3, 15, 17, 18, 21, 26, 31.	5, 10, 11, 12, 15.	–

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Record

f the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter, beginning with the year 1836.

December, January, February.		June, July, August.	
36–37, . .	25.396° F.	1837, . . .	69.130° F.
37–38, . .	26.386°	1838, . . .	69.550°
38–39, . .	25.950°	1839, . . .	70.180°
39–40, . .	20.626°	1840, . . .	68.770°
40–41, . .	23.146°	1841, . . .	69.230°
41–42, . .	28.516°	1842, . . .	68.210°
42–43, . .	23.460°	1843, . . .	67.950°
43–44, . .	21.320°	1844, . . .	67.260°
44–45, . .	25.550°	1845, . . .	70.120°
45–46, . .	22.140°	1846, . . .	68.406°
46–47, . .	25.176°	1847, . . .	68 806°
47–48, . .	28.966°	1848, . . .	69.210°
48–49, . .	23.026°	1849, . . .	69.210°
49–50, . .	27.570°	1850, . . .	68.820°
50–51, . .	25.040°	1851, . . .	66.640°
51–52, . .	21.620°	1852, . . .	66.830°
52–53, . .	27.940°	1853, . . .	67.846°
53–54, . .	23.670°	1854, . . .	69.856°
54–55, . .	23.126°	1855, . . .	67.146°
55–56, . .	20.820°	1856, . . .	69.225°
56–57, . .	22.720°	1857, . . .	67.240°
57–58, . .	26.956°	1858, . . .	67.930°
58–59, . .	24.746°	1859, . . .	65.650°
59–60, . .	24.790°	1860, . . .	66.540°
60–61, . .	24.510°	1861, . . .	66.870°
61–62, . .	24.470°	1862, . . .	66.490°
62–63, . .	27.640°	1863, . . .	66.656°
63–64, . .	26.060°	1864, . . .	69.336°
64–65, . .	21.310°	1865, . . .	68.946°
65–66, . .	25.676°	1866, . . .	67.400°
66–67, . .	25.276°	1867, . . .	67.920°

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Record of Temperature, etc. — Co

December, January, February.		Jun
1867–68, . .	20.350° F.	1868, .
1868–69, . .	26.290°	1869, .
1869–70, . .	27.866°	1870, .
1870–71, . .	26.666°	1871, .
1871–72, . .	24.630°	1872, .
1872–73, . .	21.350°	1873, .
1873–74, . .	27.286°	1874, .
1874–75, . .	21.180°	1875, .
1875–76, . .	28.156°	1876, .
1876–77, . .	23.510°	1877, .
1877–78, . .	28.506°	1878, .
1878–79, . .	24.290°	1879, .
1879–80, . .	30.506°	1880, .
1880–81, . .	21.856°	1881, .
1881–82, . .	29.256°	1882, .
1882–83, . .	24.220°	1883, .
1883–84, . .	26.506°	1884, .
1884–85, . .	22.630°	1885, .
1885–86, . .	24.846°	1886, .
1886–87, . .	22.146°	1887, .

SUMMARY

Of Average Temperature from 1836 to 1

December, January, February.	Jun
24.53 F.	

SUMMARY

Of Average Temperature from 1862 to 18

December, January, February.	Jun
25.21° F.	

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RECORD

OF THE

XIMUM AND MINIMUM TEMPERATURE, AND OF THE RAIN-FALL,

FROM 1836 TO 1887, INCLUSIVE.

e abstract, previous to the year 1883, has been obtained, through the courtesy ss S. C. Snell, from the observations of the late Prof. E. S. Snell of Amherst ge. The remainder has been taken from those at the Experiment Station.]

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MONTHS.	1836.						1837.						1838.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum	Date.	Minimum.	Date.	
January, . . .	–	–	–	–	–	4.21	20.26	42.00	31st	2.25	4th, 5th	1.75	31.99	46.00	18th	6.50	31st	2.45
February, . . .	–	–	–	–	–	3.83	26.69	39.75	16th	7.50	13th	2.42	19.55	35 50	9th	9.50	17th	1.67
March, ...	32.68	48.50	28th	17.75	12th	3.13	33.70	48 00	24th	11.75	2d	2.65	36.35	47.00	24th	17.50	2d	1.69
April, ...	47.27	59.25	28th	32.75	12th	1.98	47.42	65.25	29th	36.00	1st	4.33	40.72	55.00	29th	31.50	15th, 17th	2.02
May, ...	61.36	76.25	3d	45.50	27th	2.59	57.88	72.00	31st	38.50	1st	5.76	54.32	70.50	22d	41.50	4th	3.63
June, ...	66.37	77 50	9th	51.75	21st	3.45	68.15	77.00	30th	34.00	17th	4.49	68.63	78.00	12th	57.00	3d	4.00
July, ...	73.62	83.75	8th	65.50	8th	6.02	70.64	82.50	1st	65.50	30th	7.35	71.86	81.50	10th	61.00	23d	2.27
August, . . .	68.00	78.00	1st	57.00	11th	0.96	68.61	79.25	2d	59.50	23d	2.57	68.16	78.00	25th	56.50	27th	3.95
September, . .	62.36	77.75	20th	45.50	29th	2.28	61.42	75.00	10th	53.00	30th	1.07	62.73	72.50	8th	50.00	24th	6.38

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MONTHS.	1839.						1840.						1841.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	24.56	42.00	12th	1.50	1st	1.66	14.45	38.00	30th	—21.00	17th	3.15	25.63	50.00	8th, 9th	—17.00	5th	5.80
February, . .	29.79	39.00	27th	11.50	6th, 7th	1.75	28.50	56.00	23d	—14.00	5th	2.03	20.20	44.00	21st	—6.00	12th	1.50
March, . . .	37.54	50.50	27th	13.50	4th	1.69	34.97	64.00	4th	7.00	8th	3.18	31.90	60.00	26th	8.00	5th	2.85
April, . . .	52.18	60.50	28th	33.00	14th	4.14	48.95	79.00	23d	19.00	9th	3.98	41.63	67.00	28th	21.00	11th	4.52
May, . . .	60.71	67.50	28th	42.50	8th	3.49	57.06	88.00	28th	34.00	11th	1.91	54.39	81.00	24th	29.00	4th	3.47
June, . . .	65.40	71.50	21st	52.00	1st, 13th	3.30	65.50	88.00	29th, 30th	44.00	2d	4.60	68.35	90.00	30th	43.00	4th	1.65
July, . . .	74.40	77.00	20th	63.00	13th	9.56	70.56	94.00	17th	50.00	2d	3.34	69.53	94.00	23d	42.00	12th	2.55
August, . .	70.74	77.50	27th	53.50	29th	2.51	70.26	90.00	20th	50.00	10th, 16th	6.82	69.82	88.00	2d, 3d, 4th, 5th,	42.00	25th	3.18
September, . .	63.50	70.00	5th, 7th	43.50	29th	2.82	57.22	77.00	8th, 9th	36.00	15th, 14th	5.20	61.21	84.00	4th	46.00	27th	3.50
October, . .	53.32	61.50	19th	32.00	21st	1.78	47.39	72.00	6th	23.00	17th	5.04	42.81	64.00	30th, 31st	20.00	28th	3.73
November, . .	36.65	48.00	15th	23.00	22d, 23d	3.04	36.95	55.00	30th	18.00	21st	4.61	35.28	68.00	1st	13.00	30th	2.80
December, . .	28.93	46.00	5th	9.00	20th	7.09	23.61	44.00	10th	—2.00	25th	3.15	29.50	44.00	24th	5.00	23d	6.08
Means and Sums, .	49.81	-	-	-	-	42.83	46.28	-	-	-	-	47.01	48.85	-	-	-	-	41.63

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MONTHS.	1842.						1843.						1844.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	25.55	37.00	31st	—10.00	6th	1 02	29.73	50.00	8th, 31st	—8.00	2d	1.99	13.93	39.00	13th	—22.00	28th	3.44
February, . . .	30.50	55.00	4th	5.00	9th	3.78	16.48	37.00	11th	—15.00	17th	3.49	22.07	49.00	21st	—10.00	1st	2.18
March, . . .	37.69	68.00	4th	13.00	12th	2.39	24.52	42 00	28th	7.00	19th	5.73	35.53	56.00	25th	5.00	5th	4.12
April, . . .	46.50	82.00	22d	17.00	1st	2.92	44.63	70.00	22d	15.00	4th	4.82	51.95	83.00	14th	14.00	1st	0.57
May, . . .	52.71	78.00	19th	30.00	21st	2.40	55.95	82.00	15th	35.00	3d, 4th	2.09	57.85	84.00	25th	33.00	22d	5.59
June, . . .	64.10	84.00	19th	34.00	7th, 12th	3.18	65.28	86.00	27th	34.00	1st, 2d	5.18	65.55	86.00	27th	42.00	4th	3.00
July, . . .	71.48	90.00	30th	49.00	22d	1.95	68.76	91.00	2d	47.00	6th	2.53	68.23	86.00	14th	40.00	5th	3.81
August, . .	69.05	82.00	18th, 26th	45.00	31st	7.42	69.81	84.00	31st	53.00	1st, 2d	9.38	68.00	84.00	17th	46.00	13th	4.93
September, . .	57.43	84.00	12th	30.00	24th	3.23	61.70	87.00	4th, 5th	30.00	28th	1.57	59.55	83.00	16th	26.00	28th	1.34

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MONTHS.	1845. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1846. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1847. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.
January, . .	24.52	46.00	25th	0°	19th	4.97	24.75	45.00	2d	—1.00	19th	2.74	25.50	44.00	5th, 6th	4.00	22d	4.86
February, . .	24.86	55.00	25th	—3.00	3d	3.37	20.14	40.00	5th	—6.00	19th	2.55	24.71	47.00	3d	—8.00	24th	4.88
March, . . .	36.93	71.00	30th	8.00	12th	3.56	36.33	59.00	20th	2.00	3d	4.35	29.24	52.00	25th	9.00	14th, 16th	3.57
April, . . .	45.59	77.00	21th	24.00	6th	1.70	50.06	76.00	18th	22.00	16th	1.54	43.23	77.00	22d	5.00	1st	1.41
May, . . .	56.15	88.00	12th	30.00	10th, 31st	2.42	58.29	83.00	26th	32.00	20th	4.33	57.48	84.00	29th	34.00	1st	1.91
June, . . .	66.71	90.00	8th	41.00	7th, 18th	2.57	64.96	87.00	18th	41.00	13th	3.10	64.73	88.00	28th	42.00	13th	4.44
July, . . .	72.12	94.00	14th	46.00	25th	3.31	70.66	93.00	11th	44.00	16th	3.25	72.42	91.00	19th	46.00	29th	4.48
August, . .	71.54	89.00	10th	42.00	29th	2 79	69.63	90.00	5th	47.00	19th	2.44	69.27	85.00	11th, 17th	48.00	20th	4.06
September, . .	58.30	81.00	4th	32.00	13th, 23d	2.58	65.48	83.00	6th	37.00	27th	0.47	59.30	85.00	4th	35.00	17th	3.63
October, . .	49.64	74.00	12th	17.00	22d	4.66	47.59	81.00	9th	25.00	26th	2.09	45.97	67.00	6th	15.00	27th	3.99
November, . .	41.49	65.00	4th	12.00	29th	3.90	43.05	61.00	8th	20.00	26th	4.96	43.15	70.00	4th	5.00	30th	4.17
December, . .	21.53	38.00	15th	—10.00	13th	3.91	25.32	45.00	28th	1.00	16th	3.10	34.24	59.00	11th	3.00	27th	6.41
Means and Sums, .	47.45	-	-	-	-	39.74	48.02	-	-	-	-	34.92	47.44	-	-	-	-	47.81

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MONTHS.	1848.						1849.						1850.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	28.95	56.00	1st	−12.00	11th	2.92	20.02	46.00	26th	−8.00	11th	0.99	25.90	45.00	27th	−2.00	31st	4.75
February, . . .	23.71	43.00	23d	−2.00	11th	2.60	18.50	43.00	24th	−10.00	16th	0.99	28.42	52.00	26th	−11.00	6th	3.56
March, ...	32.63	64.00	31st	4.00	15th	3.03	35.57	60.00	31st	12.00	5th	4.21	32.43	60.00	14th	8.00	4th	1.86
April, ...	43.32	74.00	22d	25.00	3d	1.55	43.49	68.00	4th	21.00	15th	2.24	42.91	70.00	26th, 28th	19.00	11th	3.93
May, ...	59.47	86.00	18th	32.00	1st	6.18	53.42	83.00	21st	32.00	3d	3.61	53.38	73.00	13th	31.00	12th	8.72
June, ...	67.63	90.00	17th	39.00	2d	2.58	66.88	92.00	22d	39.00	9th	1.53	67.27	90.00	20th	44.00	12th	2.88
July, ...	69.45	87.00	22d	49.00	16th, 17th	4.72	72.09	93.00	13th	45.00	3d	2.25	72.08	87.00	30th	48.00	27th	6.81
August, . . .	70.56	87.00	17th	44.00	26th	1.53	68.85	83.00	4th	50.00	16th	7.86	67.10	87.00	6th	44.00	18th, 28th	6.50
September, . .	57.43	81.00	11th	31.00	28th	2.49	60.05	70.00	17th	37.00	3d	1.40	59.40	80.00	1st, 6th	32.00	30th	4.93
October, . . .	47.21	70.00	1st, 17th	28.00	9th, 14th,	5.15	47.03	68.00	17th	29.00	15th	6.36	48.18	67.00	5th	26.00	30th	2.65

MONTHS.	1851.						1852.						1853.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	23.79	48.00	26th	—5.00	5th, 8th	1.66	19.57	43.20	29th	—15.00	22d	2.42	24.26	45.00	11th	—2.50	27th	2.11
February, . .	27.89	48.00	22d	—8.00	1st	5.08	25.17	47.40	11th	—3.40	20th	3.35	26.72	51.00	6th	0.50	15th	6.69
March, . . .	35.51	73.00	31st	12.00	14th	1.28	30.86	53.00	13th	0.30	3d	3.26	33.82	56.40	30th	7.60	15th	2.39
April, . . .	46.20	67.00	24th	24.00	13th	4.43	39.44	61.00	30th	23.30	4th	4.71	44.02	76.30	29th	27.40	11th	3.79
May, . . .	55 61	82.00	13th	30.00	3d	4.07	56.05	79.00	6th	38.50	5th	2.30	56.70	84.20	26th	31.80	2d	5.40
June, . . .	63.60	88.00	30th	41.00	17th	3.69	65.38	84.00	17th	43.90	12th	2.54	66.97	91.30	21st	39.00	1st	2.64
July, . . .	69.13	87.00	17th	49.00	3d	4.31	69.95	90.00	9th, 22d	55.00	19th	3.38	68.73	85.10	9th	54.00	14th	3.59
August, . .	66.20	83.00	13th	39.00	27th	3.03	65.16	85.70	19th	48.90	4th	5.19	67.84	91.70	14th	45.90	29th	7.13
September, . .	60.93	80.00	12th	29.00	25th	2.05	58.37	85.00	3d	33.00	30th	2.48	59.54	84.70	5th	37.00	12th	5.66
October, . .	51.04	73.00	8th, 9th	31.00	17th	5.43	49.31	70.00	2d	24.30	27th	1.76	46.84	69.00	21st	24.90	30th	3.75
November, . .	34.54	56.00	2d	13.00	12th	5.30	36.42	50.80	3d	15.00	24th	6.43	39.14	59.50	19th	13.80	25th	6.24
December, . .	20.13	44.00	29th	—15.00	27th	3.17	32.85	56.00	7th	6.10	22d	4.88	26.31	42.80	10th	7.20	30th	1.84
Means and Sums,	46.21	-	-	-	-	43.50	45.71	-	-	-	-	42.72	46.65	-	-	-	-	51.23

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MONTHS.	1854.						1855.						1856.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	22.75	50.41	12th	—9.60	29th	2.01	27.26	48.00	29th	10.70	11th	5.06	15.24	34.80	17th	—7.50	10th	2.48
February, . .	21 96	45.00	2d	—4.80	5th	4.53	19.83	42.00	15th	—16.00	7th	2.70	19.02	38.60	23d	—11.00	14th	0.79
March, . . .	31.62	65.40	16th	14.00	21st	3.11	31.53	57.80	31st	7.80	*1st	1.08	25.88	44.90	24th	—9.00	10th	1.12
April, . . .	43.47	70.60	25th	23.70	3d	8.33	43.83	76.00	25th	17.00	2d	3.85	46.44	76.70	28th	16.50	1st	2.51
May, . . .	59.49	79.00	15th, 16th and 28th	34.00	7th	3.19	56.65	81.00	16th	41.50	9th	1.49	53.58	89.00	24th	38.20	4th	5.31
June, . . .	66.67	87.50	19th	39.80	1st	1.75	65.04	92.00	30th	48.00	12th	5.19	68.56	94.00	29th	48.00	1st	1.92
July, . . .	74.08	97.00	20th	57.70	14th	3.53	70.87	91.60	21st	57.20	19th	6.10	72.93	95.00	18th	55.90	2d	1.96
August, . .	68.82	88.50	13th, 22d	50.80	20th	0.99	65.53	84.50	4th	44.70	31st	2.55	66.19	87.30	1st	48.20	26th	12.13
September, . .	61.50	90.00	6th	33.80	30th	5.46	60.82	85.00	12th	33.00	20th	0.55	60.79	78.90	9th	41.80	25th	3.47
October, . .	51.53	75.80	9th	27.00	20th	2.31	49.73	73.00	5th	30.20	31st	10.08	48.63	75.50	11th	25.00	25th	1.40

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MONTHS.	1857.						1858.						1859.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	13.54	37.10	27th	—18.20	24th	3.55	28.81	51.40	25th	0	2d	3.52	22.94	39.40	26th	—19.40	11th	4.89
February, . .	31.42	61.80	25th	—2.70	3d	2.41	20.59	47 10	28th	—5.00	24th	1.60	25.59	44.10	16th	2.80	13th	3.54
March, . . .	31.08	54.50	31st	7.00	3d	2.12	31.31	57.70	31st	—8.00	4th	0.80	36.74	56.60	28th	3.50	2d, 3d	6.27
April, . . .	41.01	58.30	5th	14.30	2d	7.68	44.37	68.10	3d	28.50	7th	3.20	43.45	71.00	30th	28.70	9th	2.96
May, . . .	55.19	86.40	26th	39.80	16th	6.82	54.10	74.20	31st	40.30	18th	2.98	59.19	86.00	7th, 8th	43.90	11th, 12th	4.08
June, . . .	63.63	86.90	29th	49.00	8th	2.66	66.10	90.30	27th	51.00	15th	4.62	62.80	91.50	29th	45.00	12th	6.16
July, . . .	70.87	90.30	12th	55.50	3d	4.98	69.80	92.00	11th	58.50	24th	6.73	67.73	90.00	12th	53.00	4th, 5th	2.61
August, . . .	67.22	90.30	14th	53.60	19th	3.14	67.90	79.00	8th	58.80	4th	4.82	66.43	81.80	4th	47.40	30th	6.65
September, . .	59.90	85.70	11th	32.00	30th	3.04	50.90	85.20	9th	37.00	29th	4.14	57.10	73.80	27th	41.00	15th	4.47
October, . .	48.90	73.00	13th	25.00	22d	3 88	51.42	73.00	19th	31.50	26th	3.86	45.72	75.00	4th	24.80	26th	1.85
November, . .	39.46	67.00	9th	13.00	26th	2.07	33.91	59.00	1st	14.60	16th	2.16	41.07	65.80	13th	24.00	16th	2.96
December, . .	31.47	52.00	8th	2.20	27th	5.31	25.71	42.80	15th	0	26th	3.16	23.03	62.90	2d	—8.50	29th	4.85
Means and Sums,	46.14	-	-	-	-	47.06	45.40	-	-	-	-	41.59	45.98	-	-	-	-	51.29

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MONTHS.	1860.						1861.						1862.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	26.52	50.30	21st	—8.00	2d, 3d	1.21	20.45	38.00	25th	—17.00	13th	4.34	22.31	42.90	1st	0	8th	5.25
February, . .	24.83	52.00	23d	—7.20	18th	2.98	29.22	53.50	28th	—20.00	8th	3.28	22.10	40.00	23d	—2.00	17th	2.84
March, . . .	37.19	71.30	31st	22.80	23d	1.58	32.49	56.30	3d	5.50	7th	3.76	32.17	44.50	24th	13.80	3d	4.30
April, . . .	43.99	68.30	17th	23.10	3d	1.28	45.50	80.30	23d	18.20	4th	5.65	43.55	72.90	17th	24.30	8th	2.28
May, . . .	57.29	81.00	13th	38.90	1st	4.57	53.37	77.20	31st	33.00	2d	4.45	58.13	84.00	17th	44.00	25th	2.33
June, . . .	65.22	83.00	29th	52.00	21st	3.57	65.48	84.00	10th	51.00	6th	2.69	63.39	86.00	28th	49.50	16th	11.69
July, . . .	66.39	84.00	16th	53.00	28th	6.13	69.46	91.70	9th	56.70	2d	5.23	67.98	90.00	6th	51.90	19th	5.12
August, . . .	68.01	84.40	8th	49.10	29th	2.68	65.67	90.00	3d	48.50	15th	4.10	68.11	88.00	9th	48.00	30th	2.98
September, . .	56.78	79.00	7th	32.00	30th	6.12	59.93	82.30	15th	41.60	25th	2.75	61.06	80.00	7th	39.00	26th	2.12
October, . .	48.85	69.90	31st	28.00	1st	2.18	51.52	75.50	3d	25.00	25th	4.53	50.96	83.00	8th	26.00	24th	3.28
November, . .	42.70	66.70	2d	15.00	26th	3.52	37.82	64.00	3d	17.00	26th	3.98	39.56	68.20	1st	18.00	16th	4.76

MONTHS.	1863.						1864.						1865.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	29.08	52.00	16th	5.00	18th	5.05	24.36	44.20	29th	—1.50	7th	2.20	18.73	39.50	13th	—4.50	28th	3.48
February, . .	26.29	45.30	27th	—9.00	5th	4.43	28.49	46.80	24th	—4.30	18th	1.12	25.03	45.40	23d	—1.00	14th	2.88
March, . . .	26.13	47.30	25th	—6.00	13th	5.60	34.40	53.80	28th	15.00	22d	2.58	37.12	63.70	21st	13.00	6th	5.98
April, . . .	45.48	77.00	28th	25.00	4th	2.33	43.54	64.80	22d	31.80	5th	2.57	49.01	79.50	27th	33.00	9th	2.90
May, . . .	55.35	88.00	22d	38.30	7th	3.59	60.41	86.00	31st	40.00	3d	2.54	57.13	85.80	17th	42.80	1st	7.89
June, . . .	59.03	85.60	15th	51.00	17th	4.09	65.70	93.50	25th	47.30	10th	1.38	69.29	87.00	17th	55.90	3d	2.94
July, . . .	70.87	85.50	27th	55.30	23d	8.64	71.49	91.90	20th	53.90	26th	0.96	69.06	85.40	7th	54.80	15th	3.72
August, . .	70.07	90.00	3d	48.70	31st	6.11	70.82	98.00	1st	54.80	31st	4.40	68.58	90.00	4th	47.50	29th	1.86
September, . .	57.38	80.00	16th	32.00	23d	2.16	57.84	80.00	27th	41.00	26th	2.92	65.62	89.00	1st	35.00	28th	0.37
October, . .	49.90	71.00	19th	21.00	29th	4.04	46.37	68.70	4th	28.50	22d	2.94	45.97	72.00	1st	24.20	24th	4.98
November, . .	41.06	65.40	20th	18.00	30th	5.28	38.04	62.00	30th	10.80	17th	6.20	39.91	68.00	16th	18.50	8th	2.45
December, . .	25.34	51.50	14th	3.20	23d	4.87	30.18	49.40	1st	18.00	23d	4.63	28.92	54.90	27th	6.80	16th	3.54
Means and Sums,	46.33	-	-	-	-	56.19	47.64	-	-	-	-	34.44	47.86	-	-	-	-	42.99

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MONTHS.	1866.						1867.						1868.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	21.93	40.00	18th	—14.50	8th	1.36	18.30	33.50	24th	—5.00	16th	1.32	20.21	39.50	3d	0	13th	3.52
February, . . .	26.18	55.00	24th	—1.50	7th	4.62	31.23	50.00	14th	8.00	11th	3.65	18.21	45.00	21st	—18.30	8th	1.03
March, ...	31.64	55.80	15th	11.50	18th	3.16	30.84	53.00	31st	8.00	29th	3.12	33.80	59.80	31st	—7.30	1st	3.25
April, ...	48.63	84.20	21st	30.00	10th	2.03	45.49	66.00	15th	29.00	14th	3.79	41.96	67.50	1st	23.00	10th	4 27
May, ...	54.63	80.00	12th	40.00	2d	4.48	54.05	75.50	28th	36.00	3d	4.61	55.13	75.00	7th	36.00	8th	7.86
June, ...	65.82	90.10	25th	48.00	1st	5.66	67.06	85.00	6th	54.00	11th	5.67	66.17	88.70	20th	51.80	5th	2.44
July, ...	72.91	94.00	16th	55.00	1st	4.02	68 14	90.00	4th	55.00	31st	4.00	73.97	94.50	15th	61.00	28th	3.28
August, . . .	63.48	81.60	2d	48.00	26th	3.96	68.56	83.50	7th	48.30	31st	9.16	68.97	85.00	31st	51.00	13th	5.67
September, . .	60.00	83.10	31st	35.50	16th	4.71	59.99	80.00	17th	39.00	28th	1.11	59.47	79.50	11th	36.20	18th	10.63
October, . . .	49.50	73.00	8th	26.50	5th	3.38	49.90	76.00	18th	27.00	25th	3.85	45.30	68.00	11th	19.20	24th	1.37
November, . .	40.10	60.80	9th	16.80	26th	3.86	37.87	65.00	2d	17.50	18th	4.31	36.48	58.00	1st	23.80	20th	4.80

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MONTHS.	1869. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1870. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1871. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.
January, . .	28.04	49.00	8th	3.00	23d	3.47	30.78	54.30	23d	5.00	9th	5.87	23.27	50.00	13th	—5.50	23d	1.96
February, . .	28.01	50.60	13th	—1.00	8th	4.14	25.34	55.00	18th	6.20	25th	5.25	25.95	50.60	25th	—9.50	5th	2.91
March, . . .	27.28	53.80	27th	—9.00	1st	5.46	30.88	50.50	31st	6.50	6th	2.71	40.53	55.50	19th	24.80	29th	3.99
April, . . .	46.45	74.00	20th	26.70	4th	1.53	48.26	78.00	14th	35.00	4th	3.70	48.00	74.80	9th	27.00	1st	3.09
May, . . .	55.87	83.00	12th	35.20	2d	5.65	58.27	82.40	16th	42.80	11th	1.72	57.84	92.80	30th	41.00	5th	3.82
June, . . .	64.72	80.70	29th	47.40	8th	5.99	70.45	93.00	25th	53.50	11th	2.73	65.38	88.20	3d	51.80	10th	6.58
July, . . .	69.08	89.90	16th	53.50	2d	2.98	73.55	91.20	24th	54.50	2d	2.53	69.18	85.60	13th	54.00	11th	3.52
August, . . .	66.87	87.20	20th	50.00	31st	1.04	71.11	91.30	19th	47.00	27th	2.83	68.87	85.00	7th	50.00	20th	6.45
September, . .	62.06	85.00	20th	36.30	28th	4.32	62 32	83.50	1st	40.00	12th	1.75	52.84	78.00	3d	32.00	22d	1.30
October, . .	46.68	71.40	2d	26.80	28th	11.36	52.02	71.50	2d	26.00	27th	4.49	50.95	73.10	23d	24.30	22st	6.09
November, . .	35.92	56.90	4th	16.90	26th	2.59	39.10	61.00	9th	24.70	17th	3.28	34.03	62.00	1st	7.00	30th	3.51
December, . .	27.48	45.30	1st	—7.50	9th	4.96	28.00	47.00	2d	1.00	30th	1.84	24.62	43.30	4th	—6.50	21st	2.67
Means and Sums,	46.54	-	-	-	-	53.49	49.17	-	-	-	-	38.70	46.79	-	-	-	-	45.89

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MONTHS.	1872.						1873.						1874.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	25.11	42.90	20th	2.50	31st	1.51	20.56	42.30	14th	—22.00	30th	5.01	28.15	52.00	23d	1.20	26th	5.46
February, . . .	24.16	50.00	25th	—2.50	1st	1.89	24.00	45.00	4th	—2.50	24th	2.17	24.48	49.30	20th	—5.00	2d	2.19
March, . . .	25.27	44.00	28th	—4.80	5th	2.87	30.64	49.30	29th	1.80	6th	3.18	32.93	57.20	26th	9.70	24th	1.35
April, . . .	45 03	84.00	26th	29.00	2d	2.20	43.23	66.20	29th	33.50	11th	1.74	38.32	63.00	14th	18.70	1st	6.03
May, . . .	59.14	84.10	9th	43.70	4th	3.11	54.58	82.00	28th	39.00	3d	3.91	56.52	86.00	29th	39.00	7th	5.22
June, . . .	68.14	91.80	30th	48.70	2d	3.25	67.48	90.00	19th	50.60	4th	1.59	66.18	93.00	29th	51.30	2d	5.06
July, . . .	72.64	91.70	1st	59.10	23d	7.07	71.30	92.40	14th	56.10	19th	2.93	67.16	90.00	14th	38.00	5th	11.58
August, . .	71.60	88.80	8th	52.90	31st	5.28	67.01	86.20	2d	49.10	28th	3.47	65.58	84.00	10th, 11th	46.30	27th	2.69
September, . .	61.70	88.50	8th	39.50	4th	6.20	60.35	85.80	5th	36.20	22d	4.77	62.03	85.80	10th	39.00	23d	1.82
October, . .	48.24	69.00	6th	29.90	30th	3.64	49.93	70.50	19th	27.00	26th	6.36	47.60	66.00	8th	28.50	22d	1.85

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MONTHS.	1875. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1876. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.	1877. Temperature. Mean.	Maximum.	Date.	Minimum.	Date.	Rain in Inches.
January, . .	16.73	35.50	2d	—8.20	11th	2.90	29.85	63.00	1st	2.80	14th	2.31	20.05	43.00	27th	—3.50	24th	2.52
February, . .	17.53	50.00	23d	—4.00	10th	3.62	26.36	52.30	13th	—1.00	24th	5.53	30.78	50.00	22d	8.50	9th	0.36
March, . . .	27.79	51.00	30th	0	24th	4.20	31.60	59.00	7th	4.50	20th	7.14	33.30	52.80	23d	10.00	20th	6.97
April, . . .	40.80	63.00	29th	22.50	19th	3.33	43.60	63.30	14th	28.00	9th	3.11	47.80	75.80	24th	32.50	14th	2.45
May, . . .	57.14	84.70	23d	39.80	2d	2.19	57.50	86.00	7th	39.00	1st	3.96	58.50	84.50	31st	40.00	2d	1.93
June, . . .	65.84	89.00	24th	48.50	14th	2.89	70.61	87.70	27th	47.00	1st	3.87	67.77	88.00	2d	54.70	22d	4.59
July, . . .	69.30	91.50	6th	53.80	20th	8.15	74.19	95.00	9th	52.50	27th	4.84	71.13	89.10	26th	58.10	15th	6.47
August, . . .	68.94	84.80	31st	32.00	27th	6.17	70.54	90 00	6th	49.00	21st	0.27	71.35	87.40	28th	54.80	31st	2.79
September, . .	57.27	84.70	3d	32.50	23d	4.65	59.10	90.00	1st	41.20	27th	3.71	63.31	85.70	14th	39.00	23d	0.91
October, . .	47.90	70.30	5th	26.00	13th	3.89	45.50	71.10	21st	23.00	29th	1.12	50.50	75.40	1st	25.30	28th	6.99
November, . .	33.11	56.20	13th	—1.00	30th	3.97	40.50	71.70	2d	18.90	30th	2.49	41.92	66.80	9th	19.40	20th	5.44
December, . .	28.26	55.00	23d	—9.00	20th	1.03	19.70	42.00	13th	—1.00	17th	3.22	33.09	55.20	17th	13.00	2d	1.02
Means and Sums,	44.22	-	-	-	-	46.99	47.42	-	-	-	-	41.57	49.12	-	-	-	-	42.44

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MONTHS.	1878.						1879.						1880.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	25.29	44.40	22d	−12.50	8th	3.58	21.55	50.10	28th	−4.50	17th	1.75	31.60	47.90	4th	2.00	14th	4.58
February, . . .	27.14	53.30	27th	−3.20	3d	3.67	22.37	43.20	12th	1.00	22d	3.49	29.09	57.60	29th	−11.50	10th	3.60
March, . . .	39.24	65.10	10th	13.20	25th	2.57	33.00	51.60	11th	7.00	8th	4.98	33.46	59.80	4th	13.70	25th	2.68
April, . . .	52.17	73.10	19th	37.00	15th	5.85	43.18	72.40	28th	22.70	4th	3.85	47.54	77.70	14th	26.20	8th	2.64
May, . . .	57.38	83.20	3d	40.50	13th	2.36	60.60	83.00	31st	40.00	2d	3.32	64.15	93.00	26th	37.00	1st	1.90
June, . . .	64.73	90.20	30th	46.40	7th	6.00	66.26	90.30	1st	49.00	7th	5.37	68.52	91.10	24th	51.00	4th	1.40
July, . . .	73.33	92.20	18th	55.20	7th	2.16	71.00	91.40	4th	56.70	5th	5.75	71.81	90.50	10th	54.00	30th	6.34
August, . .	68.63	83.30	9th	49.90	26th	6.97	67.19	90.60	2d	53.20	28th	5.89	67.53	88.00	23d	45.70	16th	2.91
September, . .	63.20	84.50	1st	37.00	28th	2.82	59.02	85.60	2d	30.40	26th	2.59	63.24	90.00	5th	39.10	24th	2.69
October, . .	54.43	77.30	17th	27.00	29th	2.05	56.01	82.60	16th	20.80	26th	1.80	47.27	71.40	11th	22.90	29th	2.27

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MONTHS.	1881.						1882.						1883.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	17.92	38.00	7th	—12.40	1st	4.01	23.57	45.00	26th, 16th	—15.00	24th	5.44	21.00	42.20	31st	—2.50	23d	3.24
February, . .	24.86	47.00	10th	—7.00	2d	1.77	28.19	47.40	16th	—6.00	4th	4.23	25.02	43.10	4th	—1.30	24th	4.03
March, . . .	36.20	50.80	16th	24.40	2d	4.86	35.13	56.20	20th	17.40	15th	5.20	27.26	51.10	2d	3.00	9th	1.70
April, . . .	43.65	78.40	24th	22.10	5th	1.65	44.31	68.00	18th	23.70	1st	1.52	44.29	67.30	10th	23.50	1st	2.18
May, . . .	61.70	89.00	25th	37.00	1st	4.28	52.86	78.00	31st	39.10	3d	6.50	58.60	89.00	26th	43.00	1st	6.20
June, . . .	62.77	80.00	29th	47.70	4th	3.95	66.85	90.00	24th	52.20	1st	2.25	69.72	90.80	19th	53.70	2d	3.99
July, . . .	70.64	87.20	13th	59.20	1st	1.50	71.89	92.10	27th	56.30	1st	1.83	70.42	93.00	4th	55.00	1st	3.69
August, . .	70.49	90.80	5th	56.70	17th	2.76	70.89	93.00	15th	49.70	19th	0.25	66.39	86.20	20th	43.40	28th	1.57
September, . .	67.35	94.00	7th	49.00	14th	2.37	63.23	87.70	19th	43.70	13th	11.85	59 43	79.80	2d	36.20	10th	3.17
October, . .	52.47	86.20	1st	29.00	27th	4.24	52.72	73.80	8th	32.20	28th	1.67	46.82	77.10	14th	23.20	18th	4.31
November, . .	40.30	66.70	9th	14.00	23d	4.58	36.45	66.10	1st	12.00	28th	1.33	40.43	67.20	22d	18.00	29th	1.80
December, . .	36.01	61.40	14th	8.50	11th	6.15	26.65	48.00	24th	0	20th	1.47	27.02	53.10	8th	—12.80	23d	2.99
Means and Sums,	48.70	-	-	-	-	42.12	47.73	-	-	-	-	43.54	46.36	-	-	-	-	38.87

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MONTHS.	1884.						1885.						1886.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	21.64	40.10	18th	—8.00	6th	3.60	22.73	57.00	12th	—18.00	28th	3 78	21.85	56.00	5th	—22.00	13th, 14th	5.39
February, . . .	30.86	46.00	7th	5.10	29th	4.62	15.17	39.00	26th	—15.00	12th	3.88	23.10	52.00	15th	—11.00	5th	3.94
March, ...	32.89	54.00	25th	0	3d	5.67	23.29	50.00	28th	—11.00	18th	0.86	33.46	61.00	31st	—1.00	1st	3.31
April, ...	46.69	70.30	27th	31.20	1st	2.48	45.29	83 00	22d	19.00	15th	3.38	50.42	83.00	20th	21.00	7th	1.73
May, ...	57.35	85.20	22d	37.60	29th	2.02	54.77	85.00	19th	21.00	4th	3.08	57.26	82.00	30th	29.00	1st	3.10
June, ...	69.00	92.50	21st	50.00	15th	1.38	63.76	89.00	16th	35.00	6th, 10th	3.49	63.20	82.00	21st	40.00	4th, 19th and 20th	2.33
July, ...	68.64	93.00	2d	57.10	16th	3.75	70.41	93.00	17th	41.00	2d	2.07	68.80	95.00	4th	41.00	1st	3.82
August, . . .	69.25	92.40	20th	48.80	25th	5.10	66.05	87.00	1st, 18th	34.00	28th	8.31	66.30	90.00	27th	39.00	22d	2.60
September, . .	64.35	90.00	10th	39.00	14th	1.25	58.32	81.00	14th	27.00	11th	0.85	59.50	83.80	9th	31.60	21st	5.48
October, . . .	50.27	78.20	4th	26.50	26th	2 40	49.14	80.00	4th	24.00	26th	3.65	48.90	77.90	9th	17.00	17th	2.97

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MONTHS.	1887.					
	TEMPERATURE.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.	
nuary,	19.39	47.20	24th	—22.20	19th	4.57
ebruary,	24.15	43.80	9th	—3.80	5th	5.05
arch,	26.41	46.00	21st	—2.40	5th	4.05
pril,	41.61	74.40	10th	17.10	8th	2.98
ay,	60.91	86.50	20th	33.20	14th	1.13
ne,	65.67	91.00	30th	38.50	11th	5.09
ly,	73.71	93.60	2d	56.00	15th	8.93
ugust,	64.92	88.00	1st	42.50	14th, 28th	7.75
ptember,	55.94	80.00	7th	29.50	27th	1.22
ctober,	47.00	74.40	8th	17.00	31st	2.10
ovember,	36.49	64.80	7th	11.00	30th	3.35
ecember,	26.65	51.00	12th	—6.00	31st	4.11
eans and Sums,	45.23	-	-	-	-	50.33

C. A. GOESSMANN,

Director.

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JAMES P. LYNDE, *Treasurer, in Account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1887.		*Receipts.*	
Jan.	1,	Cash in Bank,	$400 99
	1,	Dr. C. A. Goessmann, Director,	77 82
	7,	State Treasurer,	2,500 00
April	1,	State Treasurer,	2,500 00
	11,	Dr. C. A. Goessmann, Director,	155 01
June	22,	Dr. C. A. Goessmann, Director,	117 80
July	6,	State Treasurer,	2,500 00
Oct.	1,	State Treasurer,	2,500 00
	11,	Dr. C. A. Goessmann, Director,	178 30
			$10,929 92

1887.	*Expenditures.*	
	Salaries,	$3,191 45
	Laboratory Supplies,	818 50
	Printing and Postage,	782 17
	Office Expenses,	201 34
	Farmer and Farm Labor,	1,842 05
	Farm Supplies,	560 82
	Stock and Feed,	645 92
	Miscellaneous Expenses,	364 38
	Repairs and Construction,	1,736 43
	Horses,	375 00
	Expenses of Board of Control,	148 75
	Cash in Bank Dec. 31, 1887,	263 11
		$10,929 92

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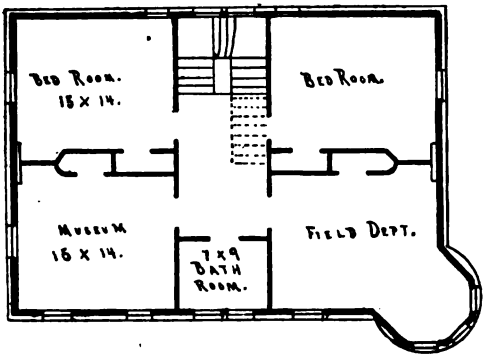
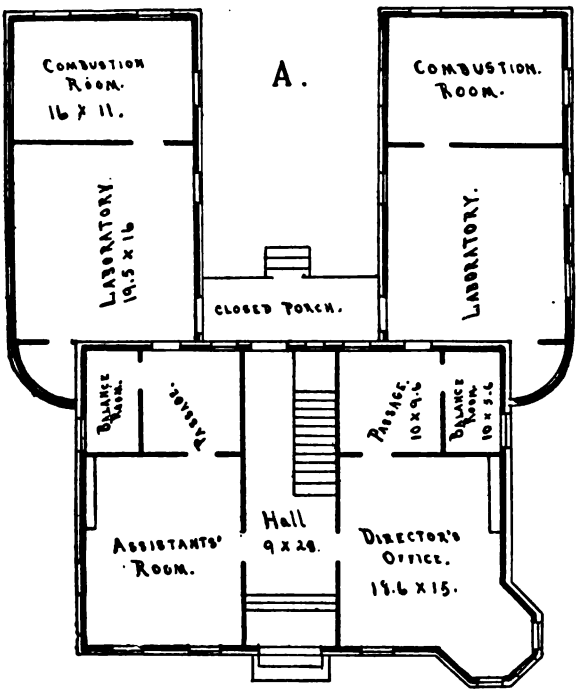
B.



STATION BUILDING — 2nd FLOOR.

A.



Scale 0 5 10 feet.

STATION BUILDING — GROUND PLAN.

A. Laboratory Building..... Ground Plan

B " " Second Floor

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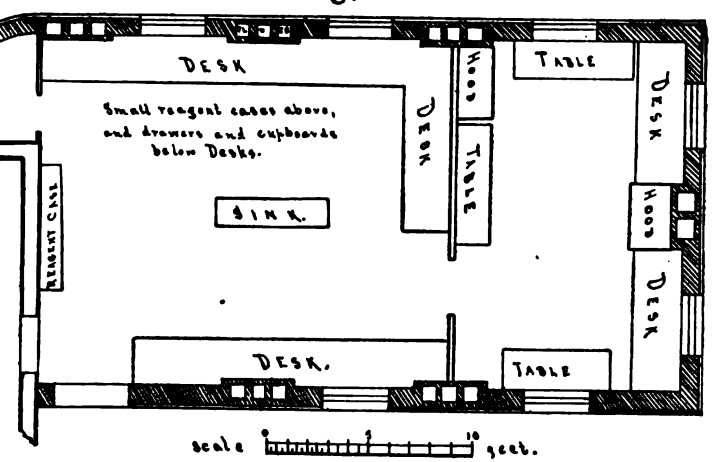
C.



PLAN OF LABORATORY.

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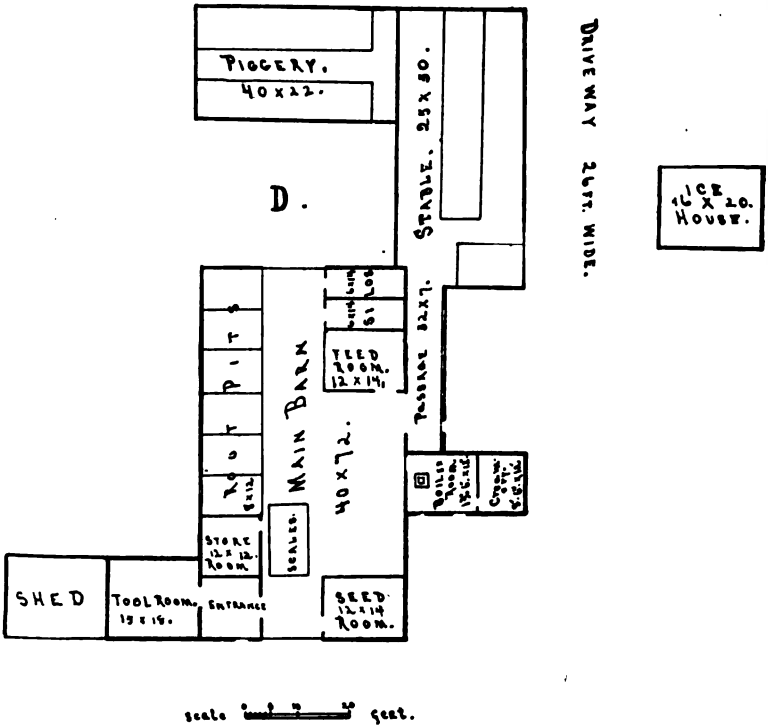

PLAN OF FARM BUILDINGS.

C. ONE WING OF CHEMICAL LABORATORY

D. PLAN OF FARM BUILDINGS.

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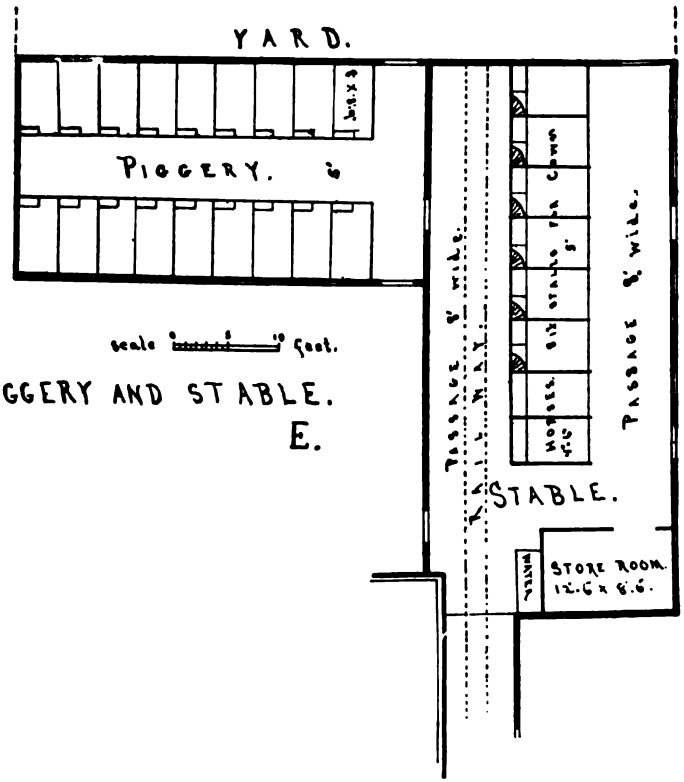

PIGGERY AND STABLE.
E.

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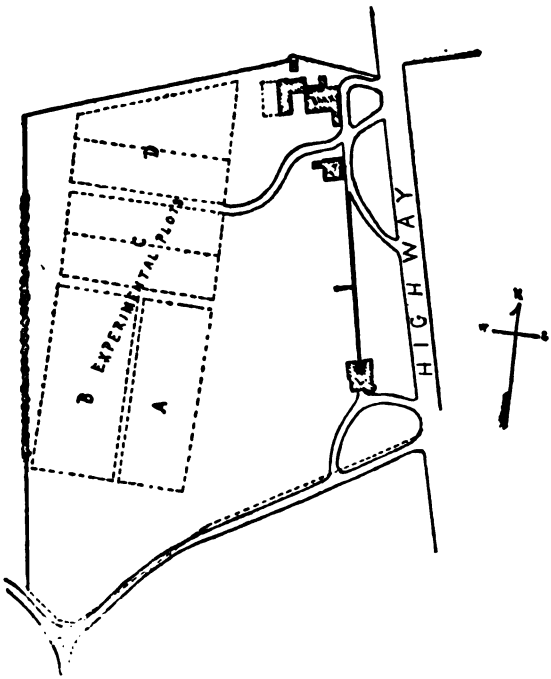

MAP OF LAND LEASED TO THE

MASSACHUSETTS EXPERIMENT STATION,

FROM THE

AGRICULTURAL COLLEGE FARM,

WEST OF THE HIGHWAY.

Area taken, 17.72 Acres.

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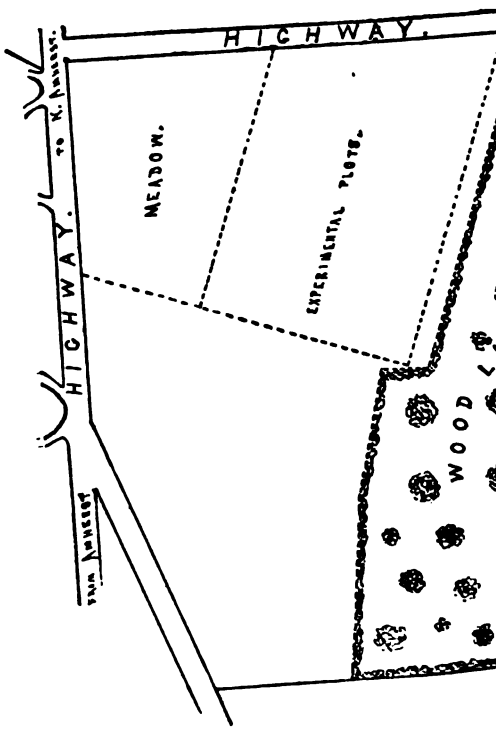

MAP OF LAND LEASED TO THE
MASSACHUSETTS EXPERIMENT STA
FROM THE
AGRICULTURAL COLLEGE FAR
EAST OF THE HIGHWAY.
Area taken, 30.52 Acres.

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SIXTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION,

AT

AMHERST, MASS.

1888.

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AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

BOARD OF CONTROL, 1888.

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* Left July 1, 1888. † Left Nov. 1, 1888. ‡ Left April 1, 1888.

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BOSTON, Jan. 9, 1889.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Sixth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

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SIXTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The past year has been, for several reasons, an eventful one in the history of the Massachusetts State Agricultural Experiment Station. The State Legislature of 1888 has passed two acts affecting the organization and the work of the Station. The membership of the Board of Control has been increased, and the management of the new regulations for the trade in commercial fertilizers has been assigned to the director of the Station. The Board of Control has also assumed the responsibility of attending to all the chemical work called for in connection with investigations instituted in the various departments of the Hatch Experiment Station, reserved by the authorities of the Massachusetts Agricultural College. The terms agreed to by the Board of Trustees of the college and the Board of Control of the Massachusetts Experiment Station allow five thousand dollars of the Hatch fund for that work. The character of the additional work, as well as the increase in financial resources, has rendered some change in the working force of the Station advisable. To meet the growing demand for assistance in adopted lines of investigation, a department of vegetable physiology has been organized with a view to assist in particular in the investigation of diseases of plants by microscopic observations and otherwise. Prof. James Ellis Humphrey of North Weymouth, Mass., a graduate of Lawrence Scientific School, Harvard University,

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late professor of botany at the University of Indiana, Bloomington, Ind., was elected to the professorship of vegetable physiology, and entered upon his duties Nov. 1, 1888. A desirable increase of assistance in the chemical department of the Station for the coming year will be provided by some members of the senior class of the Agricultural College, who are already in training at the Station.

The work carried on during the past year has been in the main in three directions, namely: to determine the cost of food for the production of milk and pork, field experiments with different kinds of farm crops, and chemical examinations of a variety of substances of interest to farmers. The results of the season are, on the whole, quite satisfactory. Unfavorable weather during a considerable part of summer and autumn interfered at times, somewhat, with a more general success in field experiments, yet not in a sufficient degree to question seriously the previous statement.

The chemical laboratory has received a valuable addition of necessary apparatus. The library of the Station has been enriched by the addition of books and journals needed for reference in the special lines of investigations instituted. The stalls for feeding experiments have been enlarged in the direction pointed out in the preceding annual report. Most of the farm buildings are, as far as circumstances permit, in a good state of preservation; some of them, however, need a new coat of paint.

The chemical examinations in the laboratory have been in various directions, and exceptionally numerous. Fodder articles, fertilizers, products as well as refuse materials of various industries, have been tested with reference to their agricultural value. Much work has been done to determine the sanitary conditions of water supply in small towns and on farms. The resources of the chemical department have been engaged to their full capacity to meet the growing call for assistance on the part of our farming community.

The work for the improvement of the farm lands has been continued. Drill culture has been largely adopted for the renovation of the lands, and green manuring has extensively served to develop and economize inherent sources of plant food. The area prepared for future field experiments has

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been enlarged in various parts of the farm. From nine to ten acres of permanent grass land have been added to our fodder sources. Every field of the farm has been made to contribute, as far as practicable, to that end. A detailed description of the work carried on in the different parts of the farm will be found in the accompanying report.

The buildings for stock feeding have been considerably enlarged for the purpose of inaugurating experiments regarding the cost of feed for the production of mutton and beef. The general arrangement for serving the feed has been improved with a view to enter, whenever advisable, upon experiments to study the rate of digestibility of fodder plants peculiar to American farm industry. The live stock of the Station consists at present of two horses, six cows, two steers, six sheep and nine pigs. All, with the exception of the horses, serve at present in experiments to ascertain the cost of feed for the production of milk or meat.

The details of the work carried on in the barn, the field and the laboratory, during the past year, are recorded in the subsequent pages, under the following headings: –

Feeding Experiments.

I. Experiments with milch cows; English hay, corn stover, fodder corn, ensilage, corn and cob meal, wheat bran and gluten meal.

II. Experiments with milch cows; green fodder, vetch and oats, Southern cow-pea, corn meal, wheat bran and gluten meal.

III. Experiments with pigs; skim milk, corn meal, corn and cob meal, gluten meal and wheat bran.

IV. On fodder supply and analyses of fodder articles.

Field Experiments.

V. Fodder corn raised with single articles of plant food.

VI. Fodder crops raised with and without complete manure.

VII. Experiments with vetch and oats, serradella and Southern cow-pea.

VIII. Experiments with potatoes, roots and miscellaneous crops.

IX. "Potato Scab," by Prof. James Ellis Humphrey.

Work in the Chemical Department.

X. Fertilizer laws and fertilizer analyses; miscellaneous analyses.

XI. Water analyses.

XII. Compilation of analyses of fodder articles, with reference to food value.

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XIII. Compilation of analyses of fodder articles, with reference to fertilizing ingredients.

XIV. Compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

XV. Meteorological observations.

The periodical publications of the Station have been continued at such intervals as circumstances advise. The public interest in the bulletins and annual reports is steadily increasing. The State authorities have authorized the publication of twenty-five thousand copies of the annual report; and the call for our bulletins has necessitated the printing of nine thousand copies, with a prospect of the need of ten thousand in the near future. The obligation imposed upon the director of the Station by the new laws for the regulation of the trade in commercial fertilizers, to issue, during a large part of the year, a monthly statement of analyses of fertilizers made under his direction, will materially increase the periodical publication. It appears advisable in the interest of economy to publish the analyses of fertilizers as far as practicable in the form of business circulars, and to reserve the discussion of experimental work to the periodical bulletins.

All parties engaged with me in the work of the Station have faithfully attended to the tasks assigned to them; and it is with particular pleasure that I publicly recognize that fact.

I cannot consider my whole duty on this occasion fulfilled without expressing my sincere thanks to you for your kind support during the past year.

Yours very respectfully,

C. A GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 9, 1889.

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ON FEEDING EXPERIMENTS.

1888.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

II. Feeding Experiments with Milch Cows; Green Fodder, Vetch and Oats, Southern Cow-pea, Hay, Rowen, Corn Meal, Wheat Bran and Gluten Meal.

III. Feeding Experiments with Pigs; Skim Milk, Corn Meal, Corn and Cob Meal, Gluten Meal and Wheat Bran.

I. Feeding Experiments with Milch Cows; English Hay, Corn Stover, Fodder Corn, Corn Ensilage, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

During the year 1886 a series of feeding experiments with milch cows was inaugurated for the purpose of comparing the feeding effects of dry corn fodder, of corn ensilage and of corn stover, as a substitute in whole or in part for English hay; and that of corn ensilage, as compared with various kinds of roots, as far as practicable, under corresponding circumstances. The same variety of corn, if not otherwise specified, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same advanced state of maturity as the one which furnished the dry corn fodder, *i. e.*, at the beginning of the glazing over of the kernels.

The daily diet of the cows consisted, at the beginning of the experiment, of three and one-quarter pounds of corn meal, an equal amount of wheat bran, and all the hay they could eat. This combination of fodder articles was adopted as the basis of our investigation mainly for the reason that

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it had been used in some of our earlier feeding experiments, and not on the assumption of its being the best possible combination of fodder articles for milch cows. The actual amount of hay consumed in each case was ascertained by weighing out a liberal supply of it and deducting subsequently the hay left over. The statement made in our records in this connection refers to the average consumption of hay per day during the feeding period.

The temporary changes in the diet, whenever decided upon, were carried out gradually, as it is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates which accompany all detailed reports of our feeding experiments, past and present, furnish exact figures in that direction This is in particular the case whenever such statements are of a special interest for an intelligent appreciation of the final conclusions presented. The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of the various fodder articles consumed was based on the average local market price per ton in Amherst, 1886–1887: —

Good English hay, .	$15 00	Rye middlings, . .	$24 00
Corn meal, . . .	23 00	Dry corn fodder (stover),	5 00
Wheat bran, . . .	20 00	Corn ensilage, . . .	2 75
Gluten meal, . . .	23 00	Carrots, ...	7 00

To assist those not yet familiar with the various points which ought to be taken into consideration when deciding the relative agricultural value of fodder articles at our disposal, the following short discourse on this subject, from the preceding annual report, is here reprinted. The value of a fodder for dairy purposes may be stated from two distinctly different stand-points: namely, with reference to its influence on the temporary yield of milk and the general condition of the animals which consume it, and in regard to its cost, *i.e.*, its physiological and commercial value. The relative commercial value of a fodder article again depends on its

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first cost in the market, and on the value of the fertilizing constituents left in the manurial matter after it has served for food. The market value and actual feeding effect of one and the same article do not necessarily correspond with each other; in fact, they rarely coincide. The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, varies under different circumstances, and depends in a controlling degree on its judicial use in compounding diets.

1. *Physiological or Feeding Value.*

As no single plant or part of plant has been found to supply economically and efficiently, to any considerable extent, the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us, therefore, to study the value of fodder articles at our disposal from both standpoints.

To ascertain the chemical composition of a fodder ration, in connection with an otherwise carefully managed feeding experiment, enables us to recognize with more certainty the causes of the varying feeding effects of one and the same fodder article, when fed in different combinations. It furnishes also a most valuable guide in the selection of suitable commercial feed stuffs from known sources to supplement economically our home-raised fodder crops. Practical experience in feeding stock has so far advanced that it seems to need no further argument to accept it as a matter of fact that the efficiency of a fodder ration in the dairy does not depend, aside from its general or special adaptation, on the mere presence of more or less of certain prominent fodder articles, but on the presence of a proper quantity and a certain relative proportion of certain prominent constituents of plants which are known to be essential for a successful support of life and of the special functions of the dairy cow.

Investigations into the relations which the various promi-

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nent constituents of plants bear to the support of animal life have rendered it advisable to classify them, in this connection, into three groups, — mineral constituents, and nitrogenous and non-nitrogenous organic constituents. For details regarding this matter, I have to refer to previous publications of the Station. (See Fourth Annual Report, pages 31–37.)

Numerous and extensive practical feeding experiments with most of our prominent fodder articles in various conditions, and with all kinds of farm live stock, have introduced the practice of reporting, in connection with the analysis of the chemist, also the result of careful feeding experiments as far as the various fodder articles have proved digestible, and were thus qualified for the support of the life and the functions of the particular kind of animal on trial. In stating the amount of the digestible portion of the fodder consumed in a feeding-experiment, it has proved useful for comparing different fodder rations, etc., to make known by a distinct record the relative proportions which has been noticed to exist between the amount of its digestible, nitrogenous and non-nitrogenous organic constituents. This relation is expressed by the name of "nutritive ratio." An examination of the description of our feeding experiments will show, for instance, that the corn meal fed (1888) contained one part of digestible nitrogenous to 9.66 parts of digestible non-nitrogenous organic matter, making the customary allowance for the higher physiological value of the fat as compared with that of starch, sugar, etc. (2.5 times higher).

The "nutritive ratios" of the articles of feed consumed in 1888 are subsequently stated as follows: —

Corn meal, ...	1 : 9.66	English hay, ...	1 : 10.52
Wheat bran, ...	1 : 3.85	Dry corn fodder, . . .	1 : 10.31
Gluten meal, ...	1 : 2.11	Stover, ...	1 : 9.3
		Corn ensilage, . . .	1 : 8.8

The results of our own analyses of these fodder articles are here turned to account for the calculation of the above-stated "nutritive ratios."

It has been noticed that, as a general rule, growing

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animals and milch cows require a richer food, — *i. e.*, a closer relation of digestible nitrogenous and non-nitrogenous organic constituents in their feed, — to do their best, than full-grown animals and moderately-worked horses and oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of nitrogenous organic constituents to 5.4 parts of digestible non-nitrogenous constituents.

2. Commercial Value or Actual Cost of a Fodder Article.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and in particular nitrogen, a fodder ingredient contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm managements depends in a considerable degree on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder, and the value of the manure resulting, deserve the careful consideration of the farmer when devising an efficient and at the same time an economical diet for his live stock.

The question whether one or the other fodder mixture will prove ultimately, under otherwise corresponding circumstances, the cheapest one, can only be answered intelligently when both the original cost of the feed consumed and the value of the manurial residue subsequently obtained are duly considered.

An examination of the fodder articles used in connection with our investigations shows, for instance, the following relation between their first cost and the commercial value of their fertilizing constituents: —

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	First cost.	Value of Fertilizing Constituents.
Corn meal,	$23 00	$7 19
Wheat bran,	23 00	12 31
Gluten meal,	27 00	17 49
English hay,	15 00	6 45
Corn ensilage,	2 75	1 31
Fodder corn,	5 00	4 77
Corn stover,	5 00	4 95
Carrots,	7 00	1 06
Lane's sugar beet,	5 00	1 60

A compilation of our own observations in this direction will be found at the close of our present report.

The close relation which quite necessarily exits in most farm managements between the system of cultivating the lands and the keeping of farm live stock for farm work, for the dairy and for the supply of food for the general market, imparts to the barn-yard manure a special if not a controlling importance as a valuable manurial resource. The barn-yard manure ought to remain, in a judicious system of mixed farming, not only the main reliance of the farmer for plant food, but also the cheapest manure at his disposal. The objections raised at times against a liberal use of barn-yard manure ought not to rest on its higher cost of production, when compared with other manurial substances in our market. The name, "barn-yard manure," is, however, too frequently used without any particular discrimination with reference to all kinds of manurial refuse obtained in connection with stock feeding and stock raising, which are frequently of widely differing composition. To approximate even fairly the comparative value of two samples obtained on different farms remains a hopeless task as long as a more definite information regarding the following points is wanting: —

(1.) The character of the fodder consumed.

(2.) The kind, the age and the function of the animal which served for its production.

(3.) The nature and the quantity of the material which served for the absorption of the animal excretions.

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(4.) The care bestowed upon collecting and preserving the entire liquid and solid excretions.

Assuming, for our present purpose, in both instances, identical conditions, as far as the kind of animal, the mode of collecting and the care of keeping the manure are concerned, it will be apparent that the relative values of the two kinds of barn-yard manure stand essentially in a direct relation to the amount of nitrogen, potash, phosphoric acid, etc., which was contained in the feed consumed.

The loss of fertilizing constituents contained in the fodder of milch cows, in consequence of the production of milk, varies quite naturally more or less in case of different cows, as well as of one and the same animal at its different stages of milk production. Whether the whole milk or only the cream is sold off from the farm deserves here not less serious consideration.

We have adopted thus far in our calculation a loss of twenty per cent., which may be considered quite a liberal allowance in case of a fair average production of milk, and where the whole milk is sold.

1886. — From the description of our earlier feeding experiments with milch cows (see Fourth Annual Report, page 11), it may be observed that the relations of the digestible nitrogenous and non-nitrogenous organic constituents in the different combinations of fodder articles which constituted, during the various feeding periods, the daily diet of the cows, varied on that occasion from 1 : 6.7 to 1 : 10.17. The closer relation was obtained by feeding, on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1 : 6.7.

and the wider ratio by feeding daily, on an average, —

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1 : 10.17.

1887. — As most well-conducted experiments with dairy cows endorse the use of a diet which has a closer relation

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between its digestible organic nitrogenous and non-nitrogenous constituents than either one of the above-stated two fodder rations used by us, it was decided to try fodder combinations which, in consequence of the addition of some concentrated commercial fodder article, would contain a larger amount of digestible nitrogenous substances. The gluten meal was selected for that purpose. The same coarse fodder articles — English hay, corn ensilage, corn stover and roots (carrots) — were used in most cases in different quantities and combinations with equal weights of corn meal, wheat bran and gluten meal. The relations between the two above-stated important groups of fodder constituents varied in the different diets used from 1 : 5 9 to 1 : 7.9. The closer relation was obtained by feeding daily, on an average, —

3¼ lbs. of corn meal, 3¼ lbs. of wheat bran, 3¼ lbs. of gluten meal, 10 lbs. of hay, 35 lbs. of carrots,	Nutritive ratio, 1 : 5.9.

and the wider ratio by feeding, on an average, —

3¼ lbs. of corn meal, 3¼ lbs. of wheat bran, 25 lbs. of hay,	Nutritive ratio, 1 : 7.9.

The entire feeding experiment (I) was subdivided into eight distinctly different feeding periods; the same number as on the preceding occasion, for the same length of time — seven months.

The dry corn fodder, the ensilage and the roots were cut before being offered as feed.

The yield of milk decreased, although at a different rate, in the case of different animals as time advanced. The shrinkage in the daily yield of milk amounted, at the end of the experiment, to from 3.2 quarts to 4.9 quarts in case of different cows. The gradual decline in the entire milk record of every cow is only once broken, namely, during the sixth feeding period, February 7 to February 21, when the yield of milk shows an increase of from .7 to 1.9 quarts per day, as compared with that of the preceding period. This change for the better was noticed when ten pounds of

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hay and thirty-four pounds of carrots were used, under otherwise corresponding circumstances, as a substitute for five pounds of hay and twenty-nine pounds of corn ensilage. The amount of dry vegetable matter contained in the hay fed with roots and in the hay fed with corn ensilage was practically the same in both instances. The feed of the sixth feeding period, containing carrots as an ingredient, is thus the most nutritive and also the most expensive.

The results of the experiment led us to the following conclusions: —

The nutritive value of our dry corn fodder (stover) compares well with that of an average quality of English hay; the same may be said of good corn ensilage in place of from one-half to two-thirds of the customary amount of hay.

The nutritive value of our dry corn fodder (stover) and of a good corn ensilage, taking into consideration pound for pound of the dry vegetable matter they contain, has proved in our case fully equal, if not superior, to that of the average English hay.

The nutritive feeding value of carrots, taking into consideration pound for pound of the dry vegetable matter they contain, exceeds that of the corn ensilage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed. The conclusions thus far stated are in full agreement with those pointed out in our earlier experiments.

The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet.

The total cost of the feed for the production of milk is lowest whenever corn fodder or corn ensilage have replaced, in the whole or in part, English hay, under otherwise corresponding circumstances.

The net cost of feed consumed for the production of one quart of milk during the various feeding periods, varies as widely as from .34 cents to 1.6 cents in case of the same cow. The net cost of the feed is obtained by deducting eighty per cent. of the value of the fertilizing constituents it contains.

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The manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed.

To avoid misconstruction regarding the statement of net cost of milk used in our description, I state once more that it does not include expenses of labor, housing, interest on investment, etc , but means merely net cost of feed after deducting eighty per cent. of its manurial value. (For details, see Fifth Annual Report, pages 11–34.)

1888. — To verify as far as practicable the above-stated conclusions, a new series of observations was decided upon. The course adopted was essentially the same as in the preceding year. English hay, fodder corn, corn ensilage and corn stover served as coarse fodder articles; and corn meal, corn and cob meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous and non-nitrogenous substances in the daily fodder rations. The repetition of a comparative test between roots and corn ensilage was left over for another season, when a larger supply of sugar beets and carrots would render the trial more decisive. The fodder corn, corn ensilage and corn stover were cut to an even length (1½–2 inches) before fed. The daily average amount of fodder corn left behind unconsumed was 5.55 pounds and that of corn stover and ensilage, 3 pounds.

Six cows, grades, served in the experiment, which was subdivided into seven feeding periods, extending over a period of four and one-half months. The same quantity of corn and cob meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily from the beginning to the close of the trial. Corn ensilage was fed in different proportions with one-half or one-fourth of English hay. Fodder corn and corn stover were fed most of the time by themselves.

The nutritive value of the different diets used has been quite close, varying from 1:5 5 to 1:6.1. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are

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in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

Local Market Value of Feed used in our Calculations.

Corn meal,	$23 00	English hay,	$15 00
Corn and cob meal,	20 70	Fodder corn,	5 00
Wheat bran,	23 00	Corn ensilage,	2 75
Gluten meal,	27 00	Corn stover,	5 00

An examination of the subsequent tabular statement of the details of the late experiment cannot fail to show that the conclusions drawn from our preceding observation in this direction are in the main fully sustained.

The high nutritive value of fodder corn, good corn ensilage and corn stover, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animals on trial, as well as the quality of the milk, point in that direction.

The daily yield of milk decreased gradually, apparently at a normal rate, during the progress of the experiment. The shrinkage in the yield of milk amounted, at the close of the trial, in the case of different cows of different milking periods, to from 1.6 to 4 quarts per day. The weight of the cows had decreased in three cases, and had increased in three.

The first cost of feed for the production of one quart of milk in case of the same cow, is, as a rule, from one-half to one cent less per quart wherever fodder corn, corn ensilage or corn stover have replaced in part or in whole the English hay. The first cost of feed for the production of one quart of milk differs, for obvious reasons, quite seriously in case of the same diet as far as different animals are concerned. This difference stands in a direct relation to the daily yield of milk; the less the latter, the higher the cost of the feed. A few results taken from our subsequent records may convey some more definite idea regarding this important circumstance.

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Fodder rations:	Fodder corn,	18–19 lbs.
	Corn and cob meal,	3¼ lbs.
	Wheat bran,	3¼ lbs.
	Gluten meal,	3¼ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	17.5 qts.	1.01 cts. per qt.	.50 cts. per qt.
Melia,	12.7 "	1.28 " "	.66 " "
Eva,	6.1 "	2.64 " "	1.39 " "

Fodder rations:	English hay,	20 lbs.
	Corn and cob meal,	3¼ lbs.
	Wheat bran,	3¼ lbs.
	Gluten meal,	3¼ lbs.

	Daily Yield of Milk.	First cost of feed.	Net cost of feed.
Daisy,	13.5 qts.	1.97 cts per qt.	1.28 cts. per qt.
Melia,	10.9 "	2.44 " "	1.59 " "
Eva,	5.6 "	4.74 " "	3.09 " "

The net cost of feed is obtained by deducting eighty per cent. of the commercial value of the fertilizing constituents it contains from its first cost. The manurial value of the feed consumed during the feeding experiments, after deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is at current market prices in every instance more than one-third of the original cost of the feed.

For further details, consult the following record: —

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FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.89	–	–	–	25.49	10.8	2.36	1 : 6.1	845
Jan. 21 to Feb. 6, . .	–	3 25	3.25	3.25	20.00	–	–	–	26.46	12.3	2.15	1 : 5.9	862
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	20.41	–	–	23.95	11.0	2.18	1 : 6.2	825
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	11.6	1.94	1 : 5.6	848
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	36.78	–	21.45	10.6	2.02	1 : 5.5	828
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	13.98	19.93	10.1	1.97	1 : 5.5	820
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.6	2.50	1 : 5.9	862

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.86	–	–	–	25.47	12.0	2.12	1 : 6.1	993
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	12.7	2.08	1 : 5.9	993
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	17.71	–	–	21.93	11.3	1.94	1 : 5.9	960
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.71	–	22.48	12.1	1.86	1 : 5 6	955
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	29.45	–	19.78	10.9	1.81	1 : 5.4	949
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	11.20	17.68	10.2	1.73	1 : 5.2	870
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.5	2.52	1 : 5.9	862

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FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.33	–	–	–	24.99	13.5	1.85	1 : 6.1	993
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	14.6	1.81	1 : 5.9	995
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.93	–	–	22.84	12 7	1.80	1 : 6.0	954
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	21.78	–	22.50	12.5	1.80	1 : 5.6	973
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	32.05	–	20.37	11.8	1.73	1 : 5 5	936
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	13.75	19.75	11.2	1.76	1 : 5.5	925
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10.9	2.43	1 : 5.9	969

EVA: *Age, 8 years; Grade, Jersey; Last Calf, Jan. 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1888.													
Jan. 6 to Jan. 16, . .	3.25	–	3.25	3.25	18.89	–	–	–	25.49	7.0	3.64	1 : 6.1	988
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.2	3.68	1 : 5.9	1,008
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	18.19	–	–	22.29	6.1	3.65	1 : 6.0	997
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	31.80	–	20.32	5.5	3.69	1 : 5.4	1,022
April 20 to April 30, . .	–	2.35	3.25	3.25	–	–	–	13.02	19.16	5.7	3.36	1 : 5.5	1,055
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	5.6	4.73	1 : 5.9	1,143

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FEEDING RECORD — *Concluded.*

LIZZIE: *Age, 6 years; Native; Last Calf, Feb. 1, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Ensilage.	Corn Stover.					
1888.													
Jan. 8 to Jan. 16, . .	3.25	–	3.25	3.25	18.31	–	–	–	25.08	9.4	2.67	1 : 6.1	1,045
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	10 6	2.50	1 : 5.9	1,055
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	20.18	–	–	23.74	8.2	2.90	1 : 6.1	1,037
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	18.92	–	21.85	9.2	2.38	1 : 5.5	1,040
March 20 to April 4, . .	–	3.25	3.25	3.25	5.00	–	26.42	–	19.09	8.6	2.22	1 : 5.3	1,073
April 20 to April 30, . .	–	3.25	3.25	3.25	–	–	–	12.70	18.90	8.7	2.17	1 : 5.4	1,055
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	7.9	3.35	1 : 5.9	1,091

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

1888.													
Jan. 21 to Feb. 6, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	19.2	1.38	1 : 5.9	1,148
Feb. 13 to Feb. 26, . .	–	3.25	3.25	3.25	–	25.00	–	–	27.40	17.5	1.56	1 : 6.5	1,102
March 1 to March 13, . .	–	3.25	3.25	3.25	10.00	–	34.46	–	25.38	17.0	1.49	1 : 5.8	1,068
March 20 to April 4, . .	–	3 25	3.25	3.25	5.00	–	47.36	–	23.86	14.3	1.67	1 : 5.8	1,084
April 20 to April 30, . .	–	3.25	3 25	3.25	–	–	–	15.32	21.02	13.6	1.55	1 : 5.7	1,100
May 9 to May 15, . .	–	3.25	3.25	3.25	20.00	–	–	–	26.46	13.5	1.96	1 : 5.9	1,102

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Total Cost of Feed per Quart of Milk.

May.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	97.2	10.8	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	2.41
Jan. 21 to Feb. 6, . .	209.1	12.3	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.16
Feb. 13 to Feb. 26, . .	154.0	11.0	–	45.50	45.50	45.50	–	285.74	–	–	2 33	1.51
March 1 to March 13, . .	162.4	11.6	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.77
March 20 to April 4, . .	169.6	10.6	–	52.00	52.00	52.00	80.00	–	588.48	–	3 26	1.93
April 20 to April 30, . .	111.1	10.1	–	35.75	35.75	35.75	–	–	–	143.22	1 65	1.59
May 9 to May 15, . .	74.2	10.6	–	22.75	22.75	22.75	140 00	–	–	–	1 86	2.51

Minnie.

1888.												
Jan. 8 to Jan. 16, . .	108.0	12.0	29.25	–	29.25	29.25	169.74	–	–	–	$2 34	2.17
Jan. 21 to Feb. 6, . .	215.9	12.7	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.09
Feb. 13 to Feb. 26, . .	158.2	11.3	–	45.50	45.50	45.50	–	247.94	–	–	2 23	1.41
March 1 to March 13, . .	157.3	12.1	–	42.25	42.25	42.25	130.00	–	282.23	–	2 87	1.82
March 20 to April 4, . .	174.4	10.9	–	52.00	52.00	52.00	80.00	–	471.20	–	3 10	1.78
April 20 to April 30, . .	112.2	10.2	–	35.75	35.75	35.75	–	–	–	139.70	1 57	1.40
May 9 to May 15, . .	73.5	10.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.53

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TOTAL COST OF FEED PER QUART OF MILK — Continued.

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	121.5	13.5	29.25	–	29.25	29.25	164.97	–	–	–	$2 30	1.89
Jan. 21 to Feb. 6, . .	248.2	14.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	1.82
Feb. 13 to Feb. 26, . .	177.8	12.7	–	45.50	45.50	45.50	–	265.02	–	–	2 27	1.28
March 1 to March 13, . .	162.5	12.5	–	42.25	42.25	42.25	130.00	–	283.14	–	2 87	1.77
March 20 to April 4, . .	188.8	11 8	–	52.00	52.00	52.00	80.00	–	512.80	–	3 16	1.67
April 20 to April 30, . .	123.2	11 2	–	35.75	35.75	35.75	–	–	–	168.52	1 74	1.33
May 9 to May 15, . .	76.3	10.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	2.44

Eva.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.												
Jan. 8 to Jan. 16, . .	63.0	7.0	29.25	–	29.25	29.25	170.01	–	–	–	$2 34	3.71
Jan. 21 to Feb. 6, . .	122.4	7.2	–	55.25	55.25	55.25	340.00	–	–	–	4 51	3.68
Feb. 13 to Feb. 26, . .	85.1	6.1	–	45.50	45.50	45.50	–	254.66	–	–	2 25	2.64
March 20 to April 4, . .	88.0	5.5	–	52.00	52.00	52.00	80.00	–	508.80	–	3 15	3.58
April 20 to April 30, . .	62 7	5.7	–	35.75	35.75	35.75	–	–	–	153.78	1 62	2.58
May 9 to May 15, . .	39.2	5.6	–	22.75	22.75	22.75	140.00	–	–	–	1 86	4.74

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TOTAL COST OF FEED PER QUART OF MILK — Concluded.

Lizzie.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Fodder Corn consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Stover consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 8 to Jan. 16, . .	84.6	9.4	29.25	–	29.25	29.25	164.79	–	–	–	$2 30	2.72
Jan. 21 to Feb. 6, . .	180.2	10.6	–	55.25	55.25	55.25	340.00	–	–	–	4 51	2.50
Feb. 13 to Feb. 26, . .	114 8	8.2	–	45.50	45.50	45.50	–	282.52	–	–	2 32	2.02
March 1 to March 13, . .	119.6	9.2	–	42.25	42.25	42.25	130.00	–	245.96	–	2 81	2.35
March 20 to April 4, . .	137.6	8.6	–	52.00	52.00	52.00	80.00	–	422.72	–	3 03	2 20
April 20 to April 30, . .	95.7	8.7	–	35.75	35 75	35.75	–	–	–	123.20	1 61	1.68
May 9 to May 15, . .	55.3	7.9	–	22.75	22.75	22.75	140.00	–	–	–	1 86	3.36

Daisy.

1888.												
Jan. 21 to Feb. 6, . .	326.4	19.2	–	55.25	55.25	55.25	340.00	–	–	–	$4 51	1.38
Feb. 13 to Feb. 26, . .	245.0	17.5	–	45.50	45 50	45.50	–	350.00	–	–	2 49	1.01
March 1 to March 13, . .	221.0	17.0	–	42.25	42.25	42.25	130.00	–	447.98	–	3 10	1.40
March 20 to April 4, . .	228.8	14.3	–	52.00	52.00	52.00	80.00	–	757.76	–	3 50	1.53
April 20 to April 30, . .	149.6	13.6	–	35.75	35.75	35.75	–	–	–	151.25	1 69	1.13
May 9 to May 15, . .	94.5	13.5	–	22.75	22.75	22.75	140.00	–	–	–	1 86	1.97

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SUMMARY OF NET COST OF FEED FOR EACH COW DURING SUCCEEDING PERIODS

PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
1. May,	$2 34	$1 03	$0 82	$1 52	1.56	860
Minnie,	2 34	1 03	82	1 52	1.41	985
Melia,	2 30	1 02	82	1 48	1.22	985
Eva,	2 34	1 03	82	1 52	2.41	985
Lizzie,	2 30	1 02	82	1 48	1.75	1,025
2. May,	4 51	1 98	1 58	2 93	1.40	880
Minnie,	4 51	1 98	1 58	2 93	1.36	1,005
Melia,	4 51	1 98	1 58	2 93	1.19	1,005
Eva,	4 51	1 98	1 58	2 93	2.39	1,030
Lizzie,	4 51	1 98	1 58	2 93	1.63	1,060
Daisy,	4 51	1 98	1 58	2 93	.90	1,145
3. May,	2 33	1 42	1 14	1 19	.77	820
Minnie,	2 23	1 33	1 06	1 17	.74	965
Melia,	2 27	1 37	1 10	1 17	.66	965
Eva,	2 25	1 34	1 07	1 18	1.39	1,010
Lizzie,	2 32	1 41	1 13	1 19	1.04	1,060
Daisy,	2 49	1 57	1 26	1 23	.50	1,105
4. May,	2 87	1 29	1 03	1 84	1.13	840
Minnie,	2 87	1 29	1 03	1 84	1.17	950
Melia,	2 87	1 29	1 03	1 84	1.13	975
Lizzie,	2 81	1 27	1 02	1 79	1.50	1,050
Daisy,	3 10	1 41	1 13	1 97	.89	1,060
5. May,	3 26	1 50	1 20	2 06	1.21	825
Minnie,	3 10	1 42	1 14	1 96	1.12	942
Melia,	3 16	1 45	1 16	2 00	1.06	897
Eva,	3 15	1 45	1 16	1 99	2.26	1,000
Lizzie,	3 03	1 39	1 11	1 92	1.40	1,045
Daisy,	3 50	1 62	1 30	2 20	.96	1,091
6. May,	1 65	93	74	91	.82	804
Minnie,	1 57	92	74	83	.74	922
Melia,	1 74	1 00	80	94	.76	935
Eva,	1 62	96	77	85	1.35	1,153
Lizzie,	1 61	88	70	91	.95	1,043
Daisy,	1 69	95	76	93	.62	1,046
7. May,	1 86	81	65	1 21	1.63	860
Minnie,	1 86	81	65	1 21	1.65	945
Melia,	1 86	81	65	1 21	1.59	972
Eva,	1 86	81	65	1 21	3.09	1,105
Lizzie,	1 86	81	65	1 21	2.19	1,087
Daisy,	1 86	81	65	1 21	1.28	1,103

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Summary.

May.

Total amount of milk produced during the above records (87 days),	977.6 qts.
Total cost of feed per quart of milk produced,	1.93 cts.
Manurial value left behind per quart of milk produced,	.73 cts.
Net cost per quart of milk produced,	1.20 cts.

Minnie.

Total amount of milk produced during the above records (87 days),	999.5 qts.
Total cost of feed per quart of milk produced,	1.85 cts.
Manurial value left behind per quart of milk produced,	.70 cts.
Net cost per quart of milk produced,	1.15 cts.

Melia.

Total amount of milk produced during the above records (87 days),	1,098.3 qts.
Total cost of feed per quart of milk produced,	1.70 cts.
Manurial value left behind per quart of milk produced,	.65 cts.
Net cost per quart of milk produced,	1.05 cts.

Eva.

Total amount of milk produced during the above records (74 days),	460.4 qts.
Total cost of feed per quart of milk produced,	3.42 cts.
Manurial value left behind per quart of milk produced,	1.31 cts.
Net cost per quart of milk produced,	2.11 cts.

Lizzie.

Total amount of milk produced during the above records (87 days),	787.8 qts.
Total cost of feed per quart of milk produced,	2.34 cts.
Manurial value left behind per quart of milk produced,	.90 cts.
Net cost per quart of milk produced,	1.44 cts.

Daisy.

Total amount of milk produced during the above records (78 days),	1,265.3 qts.
Total cost of feed per quart of milk produced,	1.36 cts.
Manurial value left behind per quart of milk produced,	.53 cts.
Net cost per quart of milk produced,	.83 cts.

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Manurial Value of Feed.

May.

FEEDING PERIODS.	Total Cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.56	860
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.40	880
Feb. 13 to Feb. 26,	2 33	1 42	1 14	1 19	.77	820
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	840
Mar. 20 to Apr. 4,	3 26	1 50	1 20	2 06	1.21	825
Apr. 20 to Apr. 30,	1 65	93	74	91	.82	804
May 9 to May 15,	1 86	81	65	1 21	1.63	860
Total, . . .	$18 82	$8 96	$7 16	$11 66	–	–

Minnie.

1888.						
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	1.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.36	1,005
Feb. 13 to Feb. 26,	2 23	1 33	1 06	1 17	.74	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.17	950
Mar. 20 to Apr. 4,	3 10	1 42	1 14	1 96	1.12	942
Apr. 20 to Apr. 30,	1 57	92	74	83	.74	922
May 9 to May 15,	1 86	81	65	1 21	1.65	945
Total, . . .	$18 48	$8 78	$7 02	$11 46	–	–

Melia.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.22	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.19	1,005
Feb. 13 to Feb. 26,	2 27	1 37	1 10	1 17	.66	965
Mar. 1 to Mar. 13,	2 87	1 29	1 03	1 84	1.13	975
Mar. 20 to Apr. 4,	3 16	1 45	1 16	2 00	1.06	897
Apr. 20 to Apr. 30,	1 74	1 00	80	94	.76	935
May 9 to May 15,	1 86	81	65	1 21	1.59	972
Total, . . .	$18 71	$8 92	$7 14	$11 57	–	–

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MANURIAL VALUE OF FEED — Concluded.

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1888.					Cents.	Lbs.
Jan. 8 to Jan. 16,	$2 34	$1 03	$0 82	$1 52	2.41	985
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	2.39	1,030
Feb. 13 to Feb. 26,	2 25	1 34	1 07	1 18	1.39	1,010
Mar. 20 to Apr. 4,	3 15	1 45	1 16	1 99	2.26	1,000
Apr. 20 to Apr. 30,	1 62	96	77	85	1.35	1,153
May 9 to May 15,	1 86	81	65	1 21	3.09	1,105
Total, . . .	$15 73	$7 57	$6 05	$9 68	–	–

Lizzie.

1888.						
Jan. 8 to Jan. 16,	$2 30	$1 02	$0 82	$1 48	1.75	1,025
Jan. 21 to Feb. 6,	4 51	1 98	1 58	2 93	1.63	1,060
Feb. 13 to Feb. 26,	2 32	1 41	1 13	1 19	1.04	1,060
Mar. 1 to Mar. 13,	2 81	1 27	1 02	1 79	1.50	1,050
Mar. 20 to Apr. 4,	3 03	1 39	1 11	1 92	1.40	1,045
Apr. 20 to Apr. 30,	1 61	88	70	91	.95	1,043
May 9 to May 15,	1 86	81	65	1 21	2.19	1,087
Total, . . .	$18 44	$8 76	$7 01	$11 43	–	–

Daisy.

1888.						
Jan. 21 to Feb. 6,	$4 51	$1 98	$1 58	$2 93	0.90	1,145
Feb. 13 to Feb. 26,	2 49	1 57	1 26	1 23	.50	1,105
Mar. 1 to Mar. 13,	3 10	1 41	1 13	1 97	.89	1,060
Mar. 20 to Apr. 4,	3 50	1 62	1 30	2 20	.96	1,091
Apr. 20 to Apr. 30,	1 69	95	76	93	.62	1,046
May 9 to May 15,	1 86	81	65	1 21	1.28	1,103
Total, . . .	$17 15	$8 34	$6 68	$10 47	–	–

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Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents per pound; potassium oxide, 4½ cents per pound.

[Per cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Fodder Corn.	Hay.	Ensilage.	Corn Stover.
Nitrogen, ...	1.796	1.453	2.780	5.120	.995	1.250	.289	1.119
Phosphoric acid, . .	.744	.688	1.857	.297	.201	.464	.112	.354
Potassium oxide, . .	.435	.548	1 071	.060	1.465	2.085	.264	.975
Valuation per 2,000 lbs.,	$7 19	$6 09	$12 31	$17 28	$4 77	$6 45	$1 31	$4 95

Analyses of Milk.

[Per cent.]

May.

1888.	Jan. 17.	Jan. 31.	Feb. 24.	Mar. 9.	Mar. 29.	April 11.	April 24.	May 3.
Solids, . .	14.04	13.64	14.30	14.18	14.05	13.76	13 91	14.36
Fat, . . .	4.13	3.64	3.91	3.55	3.95	2.64	4.18	4.71
Solids not fat, .	9.91	10.00	10.39	10.63	10.10	11.12	9.73	9.65
Minnie.								
Solids, . .	13.61	13.86	14.55	13.76	13.36	13.84	13.28	13.90
Fat, . . .	3.68	4.21	3.90	3.65	3.54	3.43	4.33	4.62
Solids not fat, .	9.93	9.65	10.65	10.11	9.82	10.41	8.95	9.28
Melia.								
Solids, . .	12.79	13.19	13.26	12.43	12.15	13.26	13.90	13.12
Fat, . . .	3.30	3.57	3.13	2.48	3.21	3.19	4.47	3.79
Solids not fat, .	9.49	9.62	10.13	9.95	8.94	10.07	9.43	9.33
Eva.								
Solids, . .	16.38	16.60	15.97	16.04	15.79	16.44	16.28	16.70
Fat, . . .	5.45	6.00	5.17	4.84	5.54	4.77	6.30	6.46
Solids not fat, .	10.93	10.60	10.80	11.20	10.25	11.67	9.89	10.24
Lizzie.								
Solids, . .	13.39	13.77	13.20	13.27	14.02	12.89	13 35	13.76
Fat, . . .	3.68	4.46	3.15	3.21	4.32	2.87	4.71	4.61
Solids not fat, .	9.71	9.31	10.05	10.06	9.70	10.02	8.64	9.15
Daisy.								
Solids, . .	13.34	11.96	12.63	13.22	12.94	12.95	12.09	12.43
Fat, . . .	4.23	3.09	2.73	3.55	3.54	3.18	3.86	3.78
Solids not fat, .	9.11	8.87	9.90	9.67	9.40	9.77	8.23	8.65

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Corn Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	–	

Corn and Cob Meal (Average).

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00
Analysis of dry matter.	
Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 8.8.

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Wheat Bran (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry matter,	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	6.59	131.80	–	–	
" cellulose,	12.80	256.00	51.20	20	
" fat,	6.00	120.00	96.00	80	
" protein (nitrogenous matter),	17.72	354.40	311.87	88	
Non-nitrogenous extract matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	–	–	1 : 2.11
Dry matter,	90.23	1,804.60	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.93	18.60	–	–	
" cellulose,	4.60	92.00	31.28	34	
" fat,	6.63	132.60	100.78	76	
" protein (nitrogenous matter),	35.43	708.60	602.31	85	
Non-nitrogenous extract matter,	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

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HAY.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.78	215.60	–	–	1 : 10.52
Dry matter,	89.22	1,784.40	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.11	142.20	–	–	
" cellulose,	35.55	711.00	412.38	58	
" fat,	2.63	52.60	24.20	46	
" protein (nitrogenous matter),	8.75	175.00	99.75	57	
Non-nitrogenous extract matter,	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.43	–	

FODDER CORN (DRY).

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	24 87	497.40	–	–	1 : 10.31
Dry matter,	75 13	1,502.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	5.14	102.80	–	–	
" cellulose,	22.26	445.20	320.60	72	
" fat,	2.62	52 40	39.30	75	
" protein (nitrogenous matter),	8.28	165.60	120.89	73	
Non-nitrogenous extract matter,	61.70	1,234.00	826.78	67	
	100.00	2,000.00	1,307.57	–	

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Corn Ensilage.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	77.24	1,544.80	–	–	1:8.8
Dry matter,	22.76	455.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4.94	98.80	–	–	
" cellulose,	20.66	413.20	297.50	72	
" fat,	3.15	63.00	47.25	75	
" protein (nitrogenous matter),	9.67	193.40	141.19	73	
Non-nitrogenous extract matter,	61.58	1,231 60	825.17	67	
	100.00	2,000.00	1,311.11	–	

Corn Stover.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.07	381.40	–	–	1:9.3
Dry matter,	80.93	1,618.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	4 22	84.40	–	–	
" cellulose,	20.93	418.60	301.39	72	
" fat,	2.63	52.60	39.45	75	
" protein (nitrogenous matter),	9.17	183.40	133.88	73	
Non-nitrogenous extract matter,	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

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II. Feeding Experiments with Milch Cows: Green Crops *v.* English Hay.

The preceding annual report contains a record of feeding experiments with milch cows, in which some noted green crops were used in place of English hay.

1887. — A mixed crop of green oats and vetch, of Southern cow-pea and of serradella, served in that connection.

Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 25 pounds.

The excess of hay left over was weighed back, and subsequently deducted from the original quantity. Three cows received periodically the above-stated daily rations and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-peas, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the Fifth Annual Report of the Station.

1888. — The experiment has been repeated with some modifications during the past season. A mixed crop of vetch and oats and one of Southern cow-pea were raised for that purpose. (See record of field C. in this report.)

The quantity of green fodder fed at stated times is somewhat less in pounds than in last year's trial, on account of the addition of gluten meal to our last year's fodder ration.

The daily green fodder ration consisted of corn meal, 3¼ pounds; wheat barn, 3¼ pounds; gluten meal, 3¼ pounds; English hay, 5 pounds; and as much of vetch and oats or cow-pea as the animal would consume, which amounted in

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the case of green vetch and oats to from 54 to 68 pounds, and in that of green Southern cow-peas from 70 to 80 pounds.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned.

Five cows, grades, were turned to account in the trial. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15.00 per ton, allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre.

This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Articles of Fodder used.

Corn meal,	$24 00	English hay,	$15 00
Corn and cob meal,	20 70	Vetch and oats,	2 75
Wheat bran,	22 50	Cow-pea,	3 14
Gluten meal,	22 50	Rowen,	15 00

The following pages contain the details of the experiment: —

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FEEDING RECORD.

MAY: *Age, 7 years; Grade, Jersey; Last Calf, June 6, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.08	2.39	1 : 6.12	905
July 10 to July 22,	3.25	–	3 25	3.25	5.00	62 42	–	–	29.12	11.65	2.50	1 : 5.51	890
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.57	–	–	–	29.10	10.64	2.73	1 : 6.11	893
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	21.63	28.36	11.83	2.40	1 : 5.00	925
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.43	–	28.63	12.59	2.27	1 : 4.50	903
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	19.43	–	–	–	25.97	11.25	2.31	1 : 6.09	916

MINNIE: *Age, 8 years; Grade, Ayrshire; Last Calf, May 3, 1887.*

1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.42	2.32	1 : 6.12	1,012
July 10 to July 22,	3.25	–	3.25	3.25	5.00	54.39	–	–	27.23	10.92	2.49	1 : 5.43	1,005
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.25	–	–	–	25.81	10.46	2.47	1 : 6.08	1,008
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	20.66	27.47	10.48	2.62	1 : 4.97	1,028
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	79.16	–	28.57	10.78	2.65	1 : 4 50	1,001
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	18.86	–	–	–	25.46	8.82	2 89	1 : 6.05	1,007

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FEEDING RECORD — *Continued.*

MELIA: *Age, 10 years; Grade, Dutch; Last Calf, Aug. 5, 1887.*

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	11.79	2.24	1 : 6.12	1,016
July 10 to July 22,	3.25	–	3.25	3.25	5.00	64.33	–	–	29 81	11.62	2.57	1 : 5.53	1,044
July 26 to Aug. 1,	3.25	–	3.25	3.25	19.11	–	–	–	25.69	10.71	2.40	1 : 6.07	1,029
Aug. 11 to Aug. 25,	3.25	–	3.25	3 25	–	–	–	21.27	28.05	11.43	2.45	1 : 4 99	1,055
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	75.34	–	27.83	11.59	2.40	1 : 4.50	1,035
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.11	–	–	–	23.90	10.39	2.30	1 : 5.90	1,035

ANNIE: *Age, 5 years; Grade, Jersey; Last Calf, June 19, 1888.*

1888.													
July 1 to July 6,	–	3.25	3.25	3.25	20.00	–	–	–	26.45	16.67	1 59	1 : 6.12	766
July 10 to July 22,	3.25	–	3.25	3.25	5.00	53.48	–	–	26.99	16.38	1.65	1 : 5.42	773
July 26 to Aug. 1,	3.25	–	3.25	3.25	16.43	–	–	–	23.30	14.36	1.71	1 : 5.84	764
Aug. 11 to Aug. 25,	3.25	–	3.25	3.25	–	–	–	19.67	26.67	14.70	1 81	1 : 4.94	763
Sept. 7 to Sept. 14,	3.25	–	3.25	3.25	5.00	–	71.00	–	26.98	15.13	1.78	1 : 4.50	774
Sept. 19 to Sept. 25,	3.25	–	3.25	3.25	17.18	–	–	–	23.97	12.64	1.90	1 : 5.91	768

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FEEDING RECORD — *Concluded.*

DAISY: *Age, 5 years; Grade, Durham; Last Calf, Jan. 5, 1888.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.					
1888.													
July 1 to July 6, ...	–	3.25	3.25	3.25	20.00	–	–	–	26.45	14.25	1.86	1 : 6 12	1,084
July 10 to July 22, ...	3.25	–	3.25	3.25	5.00	67.71	–	–	30.69	14 31	2.14	1 : 5.56	1,127
July 26 to Aug. 1, ...	3.25	–	3.25	3.25	19.89	–	–	–	26.38	13.36	1.97	1 : 6.13	1,106
Aug. 11 to Aug. 25, ...	3.25	–	3.25	3.25	–	–	–	21.87	28 57	13.68	2.08	1 : 5.01	1,113
Sept. 7 to Sept. 14, ...	3.25	–	3.25	3.25	5.00	–	80.00	–	28.74	13.88	2.07	1 : 4 50	1,105
Sept. 19 to Sept. 25, ...	3.25	–	3.25	3.25	21.00	–	–	–	27.37	9.82	2.79	1 : 6.22	1,084

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Total Cost of Feed per Quart of Milk.

May.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, ...	66.5	11.08	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.34
July 10 to July 22, ...	151.1	11.65	42.25	–	42.25	42.25	65.00	811.50	–	–	3 07	2.03
July 26 to Aug. 1, ...	74 5	10.64	22.75	–	22.75	22.75	137.00	–	–	–	1 82	2.45
Aug. 11 to Aug. 25, ...	177.5	11.83	48.75	–	48.75	48·75	–	–	–	324.50	4 13	2.33
Sept. 7 to Sept. 14, ...	100.8	12.59	26.00	–	26 00	26.00	40.00	–	635.75	–	2 20	2.18
Sept. 19 to Sept. 25, ...	78.8	11.25	22.75	–	22.75	22.75	136.00	–	–	–	1 81	2.30

Minnie.

1888.												
July 1 to July 6, ...	68.50	11.42	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.27
July 10 to July 22, ...	142.00	10.92	42.25	–	42 25	42.25	65.00	707.00	–	–	2 93	2.08
July 26 to Aug. 1, ...	73.25	10.46	22.75	–	22.75	22 75	134.75	–	–	–	1 80	2.46
Aug. 11 to Aug. 25, ...	157.25	10.48	48.75	–	48.75	48.75	–	–	–	310.00	4 02	2.56
Sept. 7 to Sept. 14, ...	86.25	10.78	26 00	–	26.00	26.00	40.00	–	633.25	–	2 20	2.55
Sept. 19 to Sept. 25, ...	61.75	8.82	22.75	–	22.75	22.75	132.00	–	–	–	1 78	2.88

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TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Melia.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6,	70.75	11.79	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	2.20
July 10 to July 22,	151.00	11.62	42.25	–	42.25	42.25	65.00	836.25	–	–	3 11	2.05
July 26 to Aug. 1,	75.00	10.71	22.75	–	22.75	22.75	133.75	–	–	–	1 79	2.39
Aug. 11 to Aug. 25,	171.50	11.43	48.75	–	48.75	48.75	–	–	–	319.00	4 09	2.38
Sept. 7 to Sept. 14,	92.75	11.59	26.00	–	26.00	26.00	40.00	–	602.75	–	2 15	2.32
Sept. 19 to Sept. 25,	72.75	10.39	22.75	–	22.75	22.75	119.75	–	–	–	1 69	2.32

Annie.

1888.												
July 1 to July 6,	100.00	16.67	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.56
July 10 to July 22,	213.00	16.38	42.25	–	42.25	42.25	65.00	695.25	–	–	2 91	1.37
July 26 to Aug. 1,	100.50	14.36	22.75	–	22.75	22.75	115.00	–	–	–	1 65	1.64
Aug. 11 to Aug. 25,	220.50	14.70	48.75	–	48.75	48.75	–	–	–	295.00	3 91	1.77
Sept. 7 to Sept. 14,	121.00	15.13	26.00	–	26.00	26.00	40.00	–	568.00	–	2 10	1.44
Sept. 19 to Sept. 25,	88.50	12.64	22.75	–	22.75	22.74	120.25	–	–	–	1 69	1.91

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TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Daisy.

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Corn Meal consumed during period.	Total amount of Corn and Cob Meal consumed during period.	Total amount of Wheat Bran consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Hay consumed during period.	Total amount of Vetch and Oats consumed during period.	Total amount of Cow-Pea consumed during period.	Total amount of Rowen consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of milk for period.
1888.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
July 1 to July 6, ...	85.50	14.25	–	19.50	19.50	19.50	120.00	–	–	–	$1 56	1.82
July 10 to July 22, ...	186.00	14.31	42.25	–	42.25	42.25	65.00	880.25	–	–	3 17	1.65
July 26 to Aug. 1, ...	93.50	13.36	22.75	–	22.75	22.75	139.25	–	–	–	1 83	1.96
Aug. 11 to Aug. 25, ...	205.25	13.68	48.75	–	48.75	48.75	–	–	–	328.00	4 15	2 02
Sept. 7 to Sept. 14, ...	111.00	13.88	26.00	–	26.00	26.00	40.00	–	640.00	–	2 21	1.99
Sept. 19 to Sept. 25, ...	68.75	9.82	22.75	–	22.75	22.75	147.00	–	–	–	1 89	2.75

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Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

[Per Cent.]

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-Pea.	Rowen.
Moisture, ...	12.78	13.69	10.87	10.59	10.78	74.02		8.84
Nitrogen, ...	1.635	1.45	2.415	5.30	1.25	.447		1.93
Phosphoric acid, . .	.746	.688	2.88	4.41	.464	.176	.09	.384
Potassium oxide, . .	.436	.548	1.64	.551	2.085	1.475	.239	2.86
Valuation per 2,000 lbs.,	$6 67	$6 00	$12 82	$18 49	$6 45	$2 94	$2 15	$9 24

Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	.95	770
July 10 to July 22,	2 91	2 03	1 62	1 29	.61	768
July 26 to Aug. 1,	1 65	0 80	0 64	1 01	1.00	763
Aug. 11 to Aug. 25,	3 91	2 29	1 83	2 08	.94	777
Sept. 7 to Sept. 14,	2 10	1 24	0 99	1 11	.92	766
Sept. 19 to Sept. 25,	1 69	0 82	0 66	1 03	1.16	781
Total, ...	$13 82	$7 94	$6 35	$7 47	–	–

Daisy.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.11	1,095
July 10 to July 22,	3 17	2 31	1 85	1 33	.71	1,125
July 26 to Aug. 1,	1 83	0 88	0 70	1 13	1.21	1,108
Aug. 11 to Aug. 25,	4 15	2 44	1 95	2 20	1.07	1,112
Sept. 7 to Sept. 14,	2 21	1 31	1 05	1 16	1.05	1,090
Sept. 19 to Sept. 25,	1 89	0 91	0 73	1 16	1.69	1,100
Total, ...	$14 81	$8 61	$6 89	$7 92	–	–

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MANURIAL VALUE OF FEED — *Concluded.*

May.

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial value of the Feed after deducting the 20 per cent. taken by the milk.	Net cost of Feed for the production of milk during period.	Net cost of Feed for the production of one quart of milk.	Weight of Animal at close of period.
1888.					Cents.	Lbs.
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.43	895
July 10 to July 22,	3 07	2 20	1 76	1 31	0 86	880
July 26 to Aug. 1,	1 82	0 88	0 70	1 12	1.50	896
Aug. 11 to Aug. 25,	4 13	2 43	1 94	2 19	1.23	916
Sept 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.15	902
Sept. 19 to Sept. 25,	1 81	0 87	0 70	1 11	1.40	931
Total, . . .	$14 59	$8 44	$6 75	$7 84	–	–

Minnie.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.39	1,010
July 10 to July 22,	2 93	2 05	1 64	1 29	.91	990
July 26 to Aug. 1,	1 80	0 86	0 69	1 11	1.52	1,007
Aug. 11 to Aug. 25,	4 02	2 36	1 89	2 13	1.35	1,022
Sept. 7 to Sept. 14,	2 20	1 30	1 04	1 16	1.34	992
Sept. 19 to Sept. 25,	1 78	0 85	0 68	1 10	1.78	1,035
Total, . . .	$14 29	$8 18	$6 55	$7 74	–	–

Melia.

1888.						
July 1 to July 6,	$1 56	$0 76	$0 61	$0 95	1.34	1,019
July 10 to July 22,	3 11	2 24	1 79	1 32	.87	1,048
July 26 to Aug. 1,	1 79	0 86	0 69	1 10	1.47	1,032
Aug. 11 to Aug. 25,	4 09	2 40	1 92	2 17	1.27	1,045
Sept. 7 to Sept. 14,	2 15	1 27	1 01	1 14	1.23	1,028
Sept. 19 to Sept. 25,	1 69	0 81	0 65	1 04	1.43	1,052
Total, . . .	$14 39	$8 34	$6 67	$7 72	–	–

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Analyses of Milk.

[Per Cent.]

May.

	July 3.	July 17.	July 24.	Aug. 7.	Aug. 21.	Sept. 4.	Sept. 15.	Sept. 25.
Water, . .	86.91	85.95	85.72	85.88	86.60	86.12	85.85	85.95
Solids, . .	13.09	14.05	14.28	14.12	13.40	13.88	14.15	14.05
Fat (in solids),	2.44	2.85	4.04	4.40	4.28	3.79	4.54	4.29

Minnie.

Water, . .	86.95	86.48	85.37	85.63	87.10	86.64	86.03	86.00
Solids, . .	13.05	13.52	14.63	14.37	12.90	13.36	13.97	14.00
Fat (in solids),	2.57	3.22	4.08	4.83	4.11	3.91	4.65	4.66

Melia.

Water, . .	86.90	86.63	86.92	86.94	87.73	86 82	87.56	85.98
Solids, . .	13.10	13.37	13.08	13.06	12.27	13.18	12.44	14.02
Fat (in solids),	3.73	3.42	3.61	3.65	3.42	3.37	3.04	4.30

Annie.

Water, . .	88.71	88.51	88.15	87.73	88.51	88.86	87.47	87.22
Solids, . .	11.29	11.49	11.85	12.27	11.49	11.14	12.53	12.78
Fat (in solids),	2.08	1.72	2.99	3.60	3.25	2.30	3.29	3.87

Daisy.

Water, . .	86.39	–	86.84	87.46	87.76	87.39	87.49	85.77
Solids, . .	13.61	–	13.16	12.54	12.24	12.61	12.51	14.23
Fat (in solids),	2.66	–	4.08	3.50	3.54	3.46	3.46	3.98

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CORN MEAL (AVERAGE).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.78	255.60	–	–	1 : 8.95
Dry matter,	87.22	1,744.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.58	31.60	–	–	
" cellulose,	1.69	33.80	11.49	34	
" fat,	3.96	79.20	60 19	76	
" protein (nitrogenous matter),	11.15	223.00	189.55	85	
Non-nitrogenous extract matter,	81.62	1,632.40	1.534.46	94	
	100.00	2,000.00	1,795.69	–	

The analyses of corn and cob meal and of English hay are the same as used in the preceding experiment.

WHEAT BRAN (AVERAGE ANALYSIS).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40	–	–	1 : 4.05
Dry matter,	89.13	1,782.60	–	–	
	100.00	2,000,00			
Analysis of dry matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	10.38	207.60	41.52	20	
" fat,	5.11	102.20	81.76	80	
" protein (nitrogenous matter),	16.96	339.20	298.50	88	
Non-nitrogenous extract matter,	60.20	1,2[illegible]4.00	963.20	80	
	100.00	2,000.00	1,384.98	–	

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Gluten Meal (Average).

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10 59	211.80	–	–	1 : 2.01
Dry matter,	89.41	1,788.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	.53	10.60	–	–	
" cellulose,	.89	17.80	6.05	34	
" fat,	5.49	109.80	83.45	76	
" protein (nitrogenous matter),	37.04	740.80	629.68	85	
Non-nitrogenous extract matter,	56 05	1,121.00	1,053.74	94	
	100.00	2,000.00	1,772.92	–	

Vetch and Oats.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	74.02	1,480.40	–	–	–
Dry matter,	25.98	519.60	–	–	–
	100.00	2,000.00	–	–	–
Analysis of dry matter.					
Crude ash,	7.39	147.80	–	–	–
" cellulose,	35.81	716.20	–	–	–
" fat,	2.29	45.80	–	–	–
" protein (nitrogenous matter),	10.76	215.20	–	–	–
Non-nitrogenous extract matter,	43.75	875.00	–	–	–
	100.00	2,000.00	–	–	–

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Cow-Pea.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.45	1,600 00	–	–	1 : 4.44
Dry matter,	19.55	391.00	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	7.44	148.80	–	–	
" cellulose,	25.88	517.60	243.27	47	
" fat,	2.62	52.40	30.92	59	
" protein (nitrogenous matter),	17.93	358.60	215 16	60	
Non-nitrogenous extract matter,	46.13	922.60	636.59	69	
	100.00	2,000.00	1,125.94	–	

Rowen.

[Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.84	176.80	–	–	1 : 6.4
Dry matter,	91.16	1,823.20	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash,	10 50	210.00	–	–	
" cellulose,	29.46	589.20	341.74	58	
" fat,	3.05	61.00	28.06	46	
" protein (nitrogenous matter),	13 20	264.00	150.48	57	
Non-nitrogenous extract matter,	43.79	875.80	551.75	63	
	100.00	2,000.00	1,072.03	–	

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Experiment Station Farm.

Milk and Creamery Record from Nov. 1, 1887, to Oct. 31, 1888.

	Quarts of Milk produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount received from Creamery.
1887.				
Nov. 1 to Nov. 30, .	1,692½	756	3.75 cents.	$28 35
Dec. 1 to Dec. 31, .	1,667	872	3.875 "	33 79
1888.				
Jan. 1 to Jan. 31, .	1,979¼	1,105	4.00 "	44 20
Feb. 1 to Feb. 29, .	2,108¾	1,067	4.00 "	42 68
March 1 to March 31, .	1,965	1,013	3.90 "	39 50
April 1 to April 30, .	1,864¼	951	3.65 "	34 71
May 1 to May 31, .	1,798¾	941	3.50 "	32 94
June 1 to June 30, .	1,701½	848	3.25 "	27 56
July 1 to July 31, .	1,966½	920	3.25 "	29 90
Aug. 1 to Aug. 31, .	1,858	894	3.50 "	31 29
Sept. 1 to Sept. 30, .	1,730¼	822	3.75 "	30 82
Oct. 1 to Oct. 31, .	1,759½	897	3.85 "	34 53
Total, . . .	22,091¼	11,086	–	$410 27

1887.

Nov., 6.62 spaces of cream make 1 pound of butter, equal to 24.85 cents per pound.

Dec., 6.69 spaces of cream make 1 pound of butter, equal to 25.94 cents per pound.

1888.

Jan., 6.63 spaces of cream make 1 pound of butter, equal to 25.54 cents per pound.

Feb., 6.60 spaces of cream make 1 pound of butter, equal to 26.40 cents per pound.

March, 6.60 spaces of cream make 1 pound of butter, equal to 25.74 cents per pound.

April, 6.65 spaces of cream make 1 pound of butter, equal to 24.27 cents per pound.

May, 6.46 spaces of cream make 1 pound of butter, equal to 22.58 cents per pound.

June, 6.35 spaces of cream make 1 pound of butter, equal to 20.63 cents per pound.

July, 6.45 spaces of cream make 1 pound of butter, equal to 20.96 cents per pound.

Aug., 6.34 spaces of cream make 1 pound of butter, equal to 22.19 cents per pound.

Sept., 6.45 spaces of cream make 1 pound of butter, equal to 24.32 cents per pound.

Oct., 6.39 spaces of cream make 1 pound of butter, equal to 24.61 cents per pound.

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III. Feeding Experiments with Pigs: Skim Milk, Corn Meal, Corn and Cob Meal, Wheat Bran and Gluten Meal.

Our annual report for 1887 contains a description of seven successive feeding experiments with growing pigs, which were instituted mainly for the purpose of ascertaining the cost of the feed required for the production of a definite weight of dressed pork.

In the first and second cases, creamery buttermilk and home-made skim milk with corn meal had furnished the sole ingredients of the daily diet of the animals on trial; whilst, during the five succeeding ones, wheat bran and gluten meal had been added as fodder constituents. (For details, see Fifth Annual Report, pages 55 to 83.)

In comparing the final results of the different experiments from a financial stand-point, adopting in all cases, for obvious reasons, a corresponding local market value of the fodder articles used, it was found that feeding skim milk or creamery buttermilk and corn meal in connection with wheat bran and gluten meal, as described in the Fifth Annual Report, experiments III., IV., V., VI., VII., had lessened the net cost of production of dressed pork.

This reduction appeared, however, to be due in the majority of experiments (III., IV., V. and VI.,) rather to a higher commercial value of the manurial refuse resulting, than to a higher nutritive effect of the stated change in the character of the diet. The results obtained in the seventh experiment alone furnished an exception to this circumstance; for, in this case, the smallest quantity of the total weight of the dry feed consumed showed not only a high commercial value of the manurial refuse resulting, but also the highest nutritive effect. The subsequent reprinted summary of the seven experiments may serve as a further illustration of the previous discussion.

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Summary of Experiments.

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II., ...	3.31	5.51	2.30	3.90
III., IV., V., ...	3.86	5.92	2.91	3.88
VI., ...	3.56	5.69	2.78	3.74
VII., ...	3.07	5.15	2.52	3.39

From the above summary it is apparent that the course of feeding adopted in the seventh experiment has given the most satisfactory pecuniary results; for the net cost of feed consumed amounted to 3.39 cents per pound of dressed pork produced, after allowing a loss of thirty per cent. of the manurial value of the feed, in consequence of the growth of the animal. As we sold our dressed pork for from 5½ to 7½ cents per pound, we received from 1.5 to 3.5 cents for labor, housing, etc.

The statement that an addition of gluten meal or of wheat bran or of both, to a diet which previously consisted only of skim milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

First. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

Second. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potash, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that

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particular diet, as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources.

It has been stated that, during our III., IV., V., VI. and VII. experiments, the same fodder articles, skim milk, corn meal, wheat bran and gluten meal, had been used to compound the daily diet; and that the seventh feeding experiment had yielded the highest profits on the same basis of selling price. As the daily fodder rations thus in all of these trials had consisted of the same kind of fodder ingredients, and as at all periods of the experiments the call for food had been attended to with care, it became evident that the particular mode of combining at different times the same fodder ingredients to make up the daily diet had to be considered the principal cause of the difference in our results.

To test the correctness of this conclusion it was decided to constitute a new experiment. The same mode of compounding the daily fodder ration for different periods of growth, which had been adopted during the seventh experiment, was to be carried out with a new lot of pigs. (See experiments VIII. and IX. further on.)

The following short abstract, taken from a more detailed description of the seventh feeding experiment in our last annual report, cannot fail to assist in a desirable understanding of the question involved: —

Seven animals, crosses between White Chester and Black Berkshire, served in this experiment (VII.). Their live

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weights were from twenty-two to twenty-six pounds in case of different animals. The same fodder articles were used as in the third, fourth, fifth and sixth experiments; they were, however, fed in different proportions. The daily ration of corn meal was gradually increased during the progress of the experiment, for the purpose of altering the relative proportion between the nitrogenous and non-nitrogenous matter in the feed. The relative proportion of one part of digestible nitrogenous matter to two and nine-tenths parts of digestible non-nitrogenous matter was changed at stated periods until it reached 1 : 4.28; practically, three feeding periods.

AVERAGE OF DAILY RATIONS (EXPERIMENT VII.).

	Corn Meal (Ounces).	Skim Milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
June 28 to July 11,	8.00	4	-	-	I.	1:2.91
July 12 to July 25,	12.00	6	-	-		
July 26 to July 28,	12.00	6	1 34	2.66	II.	1:2.85
July 29 to Aug. 8,	12.00	6	2.00	4.00		
Aug. 9 to Aug. 15,	14.67	6	2.66	2.66	III.	1:3.34
Aug. 16 to Aug. 23,	17.34	6	5.33	5.33		
Aug. 24 to Aug. 29,	20 00	6	8.00	8.00		
Aug. 30 to Sept. 12,	23.34	6	11.35	11.35		
Sept. 13 to Sept. 26,	29.00	6	17.00	17.00		
Sept. 27 to Oct. 11,	47.00	6	12.00	12.00	IV.	1:4.28
Oct. 12 to Oct. 27.	62.66	6	15.66	15.66		

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SUMMARY OF EXPERIMENT VII.

MARK OF PIG.	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment (in lbs.).	Dressed Weight gained during Experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
N, ...	202.93	176.0	60.04	61.66	163.75	129.36	5.39
O, ...	203.09	176.0	60.21	61.83	161.00	127.19	5.49
P, ...	203.00	176.0	60.21	61.83	174.00	139.20	5.02
Q, ...	194.09	173.0	57.71	59.93	164.50	128.31	5.27
R, ...	194.43	173.0	58.04	59.66	177.50	138.45	4.89
S, ...	194.43	173.0	58.04	59.66	162.50	128.38	5.26
T, ...	194.43	173.0	58.04	59.66	178.25	140.85	4.80
	1,386.40	1,220.0	412.29	424.23	1,181.50	931.74	–

Total Cost of Feed consumed during the Above-stated Experiment (1887).

1,386.40 lbs. corn meal, at $24.00 per ton, ...	$16 64
1,220.00 gals. skim milk, at 1.8 cents per gallon, ...	21 96
412.29 lbs. wheat bran, at $22.50 per ton, ...	4 64
424.23 lbs. gluten meal, at $22.50 per ton, ...	5 77
	$48 01

Average cost of feed for production of one pound of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Total.
$5 52	$11 32	$2 97	$3 71	$23 52

Manurial value of feed for production of one pound of dressed pork, 2.52 cents.

The cost of feed consumed varied, in case of different animals, from 4.80 to 5.49 cents per pound of dressed pork produced.

Taking the entire lot of animals into consideration, it amounts to 5.15 cents per pound of dressed pork obtained. The amount of dry matter contained in the feed required for the production of one pound of dressed pork varied from 2.83 to 3.24 pounds.

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Basis of Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used (1887).

	Per Cent.			
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.
Moisture,	10.00	90.00	10.80	8.80
Nitrogen (17 cents per lb.),	1.96	0.55	2.80	5.03
Phosphoric acid (6 cents per lb.),	0.77	0.17	2.36	0.30
Potassium oxide (4½ cents per lb.),	0.45	0.20	1.36	0.03
Valuation per 2,000 lbs.,	$7.97	$2.25	$13.51	$17.49

Eighth Feeding Experiment.

Six animals of a mixed breed, weighing from twenty-three to twenty-nine pounds, served in the experiment. The latter began Nov. 8, 1887, and lasted until March 12, 1888, or 124 days; the average of the individual live weight had reached 185 pounds. Skim milk, corn meal or corn and cob meal, wheat bran and gluten meal, furnished the fodder ingredients of the daily diet. The corn and cob meal took the place of the clear corn meal on the 8th of January. The daily ration of skim milk reached, within the first week, six quarts per head. This amount, being the limit of our home supply, was fed daily until the close of the experiment. Skim milk and corn meal, two ounces of the latter to one quart of the former, constituted the diet for about three weeks, when the steadily increasing demand for food was supplied by a gradually increasing quantity of a mixture consisting of two weight parts of gluten meal and one weight part of wheat bran. On the 3d of January, at the beginning of the third month, the daily diet was changed; the latter consisted thereafter of six quarts of skim milk and a mixture prepared of four weight parts of corn and cob meal, one weight part of wheat bran, and one weight part of gluten meal. The quantity required of the latter to meet the daily wants of the animals began with forty-eight ounces per head, and rose gradually to seventy-two ounces. (See, for details, subsequent tabular statement.)

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AVERAGE OF DAILY RATIONS (EXPERIMENT VIII.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1887.							
Nov. 8 to Nov. 15, . .	10	5	-	-	-	I.	1:2.92
Nov. 16 to Nov. 29, . .	12	6	-	-	-		
Nov. 30 to Dec. 13, . .	12	6	2.33	4.76	-	II.	1:2.80
Dec. 14 to Dec. 20, . .	12	6	5.35	11.06	-		
1888.							
Dec. 21 to Jan. 3, . .	12	6	9.43	18.86	-		
Jan. 4 to Jan. 7, . .	32	6	8.00	8.00	-	III.	1:3.80
Jan. 8 to Jan. 16, . .	-	6	8.87	8.87	35.48		
Jan. 17 to Jan. 30, . .	-	6	9.81	9.81	39.24		
Jan. 31 to Feb. 20, . .	-	6	8.00	8.00	48.00	IV.	1:4.17
Feb. 21 to March 11, . .	-	6	8.81	8.81	52.86		

The entire experiment was managed, as far as practicable, to serve as a repetition of our seventh feeding experiment. The substitution of the corn and cob meal of our own production from a superior home-raised corn, for the clear corn meal of our general market, may well be considered of but little consequence. This view is fully supported by a careful analysis of both.

The financial results of the eighth experiment, like those of the seventh, are superior to those obtained in the preceding five feeding experiments. This fact becomes still more worthy of notice when considering that the seventh experiment was carried on during a warmer period of the year, and thus under more favorable circumstances than the eighth experiment. Our late results seem to confirm the conclusions arrived at in our previous experiments, namely: —

First. A gradual periodical change, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed, is recommendable in the interest of good economy.

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Second. The feeding effect of one and the same diet changes with the advancing growth of the animal on trial.

Third. The power of assimilating food and of converting it into live weight decreases with the progress in age.

Fourth. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from 175 to 180 pounds is only advisable when exceptionally high market prices for dressed pork can be secured.

In addition to what has been said on this particular point in previous communications, I insert here, in a tabular form, the estimated cost of feed used for the production of one pound of live weight during the succeeding stages of growth of the entire lot of pigs which served in the eighth experiment.

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live weight of animals at close of feeding period (in lbs.).	Gain in live weight during period (in lbs.).	One hundred lbs. of dry matter in feed produced live weight (in lbs.).	Cost of feed for production of one lb. of live weight (in cts.).
U. I. Feeding period, . .	48.50	22.50	63.4	3.24
II. " " . .	96.50	48.00	51.2	3.58
III. " " . .	134.00	37.50	33.2	4.80
IV. " " . .	189.00	55.00	27.3	5.40
V. I. Feeding period, . .	43.00	20.00	56.3	3.65
II. " " . .	91.00	48.00	51.2	3.58
III. " " . .	132.00	41.00	35.8	4.44
IV. " " . .	198.00	66.00	32.8	4.50
W. I. Feeding period, . .	44.00	21.50	60.5	3.40
II. " " . .	96.00	52.00	55.5	3.31
III. " " . .	130.00	34.00	30.1	5.29
IV. " " . .	187.00	57.00	28.3	5.21
X. I. Feeding period, . .	46.00	21.00	59.1	3.48
II. " " . .	93.00	47.00	50.1	3.66
III. " " . .	128.00	35.00	30.6	5.20
IV. " " . .	178.50	50.50	25.0	5.88
Y. I. Feeding period, . .	46.00	21.00	59.1	3.48
II. " " . .	93.50	47.50	50.7	3.62
III. " " . .	133.00	39.50	34.5	4.61
IV. " " . .	181.50	48.50	23.8	6.12
Z. I. Feeding period, . .	52.00	22.50	63.4	3.24
II. " " . .	97.00	45.00	48.0	3.82
III. " " . .	132.50	35.50	31.1	5.13
IV. " " . .	184.50	52.00	25.8	5.71

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[U.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	26.00	48.50	1 1
Nov. 30 to Jan. 3,	210 00	25.88	12.41	24.83	-	1:2.30	48.50	96.50	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1:3.80	96.50	134 00	1 5
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	134.00	189.00	1 5

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ... 133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ... 43.69 "
49.68 lbs. wheat bran, equal to dry matter, ... 44.15 "
62.10 lbs. gluten meal, equal to dry matter, ... 56.03 "
182.59 lbs. corn and cob meal, equal to dry matter, . . 157.59 "

Total amount of dry matter, ... 434.84 lbs.

Live weight of animal at beginning of experiment, . . 26.00 lbs.
Live weight at time of killing, ... 189.00 "
Live weight gained during experiment, ... 163.00 "
Dressed weight at time of killing, ... 154.00 "
Loss in weight by dressing, ... 35 lbs., or 18.52 per cent.
Dressed weight gained during experiment, ... 132.82 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ... $3.33
50.26 lbs. corn meal, at $23.00 per ton, ...58
49.68 lbs. wheat bran, at $23.00 per ton, ...57
62.10 lbs. gluten meal, at $27.00 per ton, ...84
182.59 lbs. corn and cob meal, at $20.70 per ton, ... 1.90

$7.22

2.69 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.28 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.44 cents.

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PERIOD I.	Cost of feed consumed during period, . .	$0.73
	22.50 lbs. live weight gained; cost per lb., .	3.24 cts.
	18.33 lbs. dressed weight gained; cost per lb., .	3.98 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	48.00 lbs. live weight gained; cost per lb., .	3.58 cts.
	39.11 lbs. dressed weight gained; cost per lb., .	4 40 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.80
	37.50 lbs. live weight gained; cost per lb., .	4.80 cts.
	30.55 lbs. dressed weight gained; cost per lb., .	5.89 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	55.00 lbs. live weight gained; cost per lb., .	5.40 cts.
	44.81 lbs. dressed weight gained; cost per lb., .	6.63 cts.

[V.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1 : 2.92	23.00	43.00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1 : 2.30	43.00	91.00	1 6
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1 : 3.80	91.00	132.00	1 7
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1 : 4.17	132.00	198.00	1 10

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49 85 lbs. wheat bran, equal to dry matter, ...	44.30 "
62.27 lbs. gluten meal, equal to dry matter, ...	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . .	158.18 "
Total amount of dry matter, ...	435.74 lbs.

Live weight at beginning of experiment, ...	23.00 lbs.
Live weight at time of killing, ...	198.00 "
Live weight gained during experiment, ...	175.00 "
Dressed weight at time of killing, ...	160.00 "
Loss in weight by dressing, ...	38 lbs., or 19.19 per cent.
Dressed weight gained during experiment, ...	141.41 lbs.

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Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal at $23.00 per ton, ...	.58
49.85 lbs. wheat bran, at $23.00 per ton, ...	.57
62.27 lbs. gluten meal, at $27.00 per ton, ...	.84
183.27 lbs. corn and cob meal, at $20.70 per ton, ...	1.91
	$7.23

2.49 lbs. dry matter yielded 1 lb. of live weight, and 3.08 lbs. dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.11 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	20.00 lbs. live weight gained; cost per lb., . .	3.65 cts.
	16.16 lbs. dressed weight gained; cost per lb., .	4.52 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	48.00 lbs. live weight gained; cost per lb., . .	3.58 cts.
	38.79 lbs. dressed weight gained; cost per lb., .	4.43 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	41.00 lbs. live weight gained; cost per lb., . .	4.44 cts.
	33.13 lbs. dressed weight gained; cost per lb., .	5.49 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	66.00 lbs. live weight gained; cost per lb., . .	4.50 cts.
	53.33 lbs. dressed weight gained; cost per lb., .	5.57 cts.

[W.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2 92	22.50	44.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1:2.30	44.00	96.00	1 8
Jan. 4 to Jan. 30,	162.00	9.00	16.00	16.00	55.00	1:3.80	96 00	130.00	1 2
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	130.00	187.00	1 6

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49.68 lbs. wheat bran, equal to dry matter, ...	44.15 "
62.10 lbs. gluten meal, equal to dry matter, ...	56.03 "
182.59 lbs. corn and cob meal, equal to dry matter, . .	157.59 "
Total amount of dry matter, ...	434.84 lbs.

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Live weight of animal at beginning of experiment, . .	22.50 lbs.
Live weight at time of killing, ...	187.00 "
Live weight gained during experiment, ...	164.50 "
Dressed weight at time of killing, ...	151.00 "
Loss in weight by dressing, ...	36 lbs., or 19.25 per cent.
Dressed weight gained during experiment, ...	132.83 "

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.68 lbs. wheat bran, at $23.00 per ton, ...	.57
62.10 lbs. gluten meal at $27.00 per ton, ...	.84
182.59 lbs. corn and cob meal at $20.70 per ton, ...	1.90
	$7.22

2.64 lbs. dry matter yielded 1 lb. live weight, and 3.27 lbs. dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. dressed pork, 5.44 cents.

PERIOD I.	Cost of feed consumed during period, . .	$0.73
	21.50 lbs. live weight gained; cost per lb., . .	3.40 cts.
	17.36 lbs. dressed weight gained; cost per lb., .	4.20 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	52.00 lbs. live weight gained; cost per lb., . .	3.31 cts.
	41.99 lbs. dressed weight gained; cost per lb., .	4.10 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.80
	34.00 lbs. live weight gained; cost per lb., . .	5.29 cts.
	27.45 lbs. dressed weight gained; cost per lb., .	6.56 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	57.00 lbs. live weight gained; cost per lb., . .	5.21 cts.
	46.03 lbs. dressed weight gained; cost per lb., .	6.45 cts.

[X.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	–	–	–	1:2.92	25.00	46 00	0 15
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	–	1:2.30	46.00	93 00	1 5
Jan. 4 to Jan. 30,	162.00	9 00	16.17	16.17	55.68	1:3.81	93.00	123.00	1 3
Jan. 31 to Mar. 12,	246.00	–	21.27	21.27	127.59	1:4 17	123.00	173.50	1 3

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Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter,	133.38 lbs.
50 26 lbs. corn meal, equal to dry matter,	43.69 "
49.85 lbs. wheat bran, equal to dry matter,	44.30 "
62.27 lbs. gluten meal, equal to dry matter,	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter,	158.18 "
	435.74 lbs.

Live weight of animal at beginning of experiment,	25.00 lbs.
Live weight at time of killing,	178.50 "
Live weight gained during experiment,	153.50 "
Dressed weight at time of killing,	160.00 "
Loss in weight by dressing,	18.50 lbs., or 10.38 per cent.
Dressed weight gained during experiment,	137.59 lbs.

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon,	$3.33
50.26 lbs. corn meal, at $23.00 a ton,	.58
49.85 lbs. wheat bran, at $23.00 per ton,	.57
62.27 lbs. gluten meal, at $27.00 per ton,	.84
183.27 lbs. corn and cob meal, at $20.70 per ton,	1.91
	$7.23

2.84 lbs. of dry matter yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.33 cts.

PERIOD I.	Cost of feed consumed during period,	$0.73
	21.00 lbs. live weight gained; cost per lb.,	3.48 cts.
	18.82 lbs. dressed weight gained; cost per lb.,	3.88 cts.
PERIOD II.	Cost of feed consumed during period,	$1.72
	47.00 lbs. live weight gained; cost per lb.,	3.66 cts.
	42.12 lbs. dressed weight gained; cost per lb.,	4.08 cts.
PERIOD III.	Cost of feed consumed during period,	$1.82
	35.00 lbs. live weight gained; cost per lb.,	5.20 cts.
	31.37 lbs. dressed weight gained; cost per lb.,	5.80 cts.
PERIOD IV.	Cost of feed consumed during period,	$2.97
	50.50 lbs. live weight gained; cost per lb.,	5.88 cts.
	45.26 lbs. dressed weight gained; cost per lb.,	6.56 cts.

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[Y.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	25.00	46.00	0 15
Nov. 30 to Jan. 3,	210.00	25 88	12.41	24.83	-	1:2.30	46.00	93.50	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	93.50	133.00	1 6
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	133.00	181.50	1 2

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ... 133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ... 43.69 "
49.85 lbs. wheat bran, equal to dry matter, ... 44.30 "
62.27 lbs. gluten meal, equal to dry matter, ... 56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . . 158.18 "

Total amount of dry matter, ... 435.74 lbs.

Live weight of animal at beginning of experiment, . . 25.00 lbs.
Live weight at time of killing, ... 181.50 "
Live weight gained during experiment, ... 156.50 "
Dressed weight at time of killing, ... 150.00 "
Loss in weight by dressing, ... 31.00 lbs., or 17.08 per cent.
Dressed weight gained during experiment, ... 129.27 lbs

Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ... $3.33
50.26 lbs. corn meal at $23.00 per ton, ...58
49.85 lbs. wheat bran, at $23.00 per ton, ...57
62.27 lbs. gluten meal at $27.00 per ton, ...84
183.27 lbs. corn and cob meal, at $20.70 per ton, ... 1.91

$7.23

2.78 lbs. of dry matter yielded 1 lb. of live weight, and 3.37 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.59 cents.

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PERIOD I.	Cost of feed consumed during period, . .	$0.73
	21.00 lbs. live weight gained; cost per lb., .	3.48 cts.
	17.83 lbs. dressed weight gained; cost per lb., .	4.09 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	47.50 lbs. live weight gained; cost per lb., .	3.62 cts.
	39.39 lbs. dressed weight gained; cost per lb., .	4.37 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	39.50 lbs. live weight gained; cost per lb., .	4.61 cts.
	32.75 lbs. dressed weight gained; cost per lb., .	5.56 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	48.50 lbs. live weight gained; cost per lb., . .	6.12 cts.
	40.22 lbs. dressed weight gained; cost per lb., .	7.38 cts.

[Z.]

PERIODS.	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1887 and 1888.									lb. oz.
Nov. 8 to Nov. 29,	123.00	15.38	-	-	-	1:2.92	29.50	52.00	1 0
Nov. 30 to Jan. 3,	210.00	25.88	12.41	24.83	-	1:2.30	52.00	97.00	1 5
Jan. 4 to Jan. 30,	162.00	9.00	16.17	16.17	55.68	1:3.81	97.00	132.50	1 4
Jan. 31 to Mar. 12,	246.00	-	21.27	21.27	127.59	1:4.17	132.50	184.50	1 4

Total Amount of Feed consumed from Nov. 8 to March 12.

741 qts. skim milk, equal to dry matter, ...	133.38 lbs.
50.26 lbs. corn meal, equal to dry matter, ...	43.69 "
49.85 lbs. wheat bran, equal to dry matter, ...	44.30 "
62.27 lbs. gluten meal, equal to dry matter, ...	56.19 "
183.27 lbs. corn and cob meal, equal to dry matter, . .	158.18 "
Total amount of dry matter, ...	435.74 lbs.

Live weight of animal at beginning of experiment, . .	29.50 lbs.
Live weight at time of killing, ...	184.50 "
Live weight gained during experiment, ...	155.00 "
Dressed weight at time of killing, ...	150.00 "
Loss in weight by dressing, ...	34.50 lbs., or 18.70 per cent.
Dressed weight gained during experiment, ...	126.02 lbs.

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Cost of Feed consumed during Experiment.

185.25 gals. skim milk, at 1.8 cents per gallon, ...	$3.33
50.26 lbs. corn meal, at $23.00 per ton, ...	.58
49.85 lbs. wheat bran, at $23.00 per ton, ...	.57
62.27 lbs. gluten meal, at $27.00 per ton, ...	.84
183.27 lbs. corn and cob meal, at $20.70 per ton, ...	1.91
	$7.23

2.81 lbs. of dry matter yielded 1 lb. live weight, and 3.46 lbs. of dry matter yielded 1 lb. dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.74 cts.

PERIOD I.	Cost of food consumed during period, . .	$0.73
	22.50 lbs. live weight gained; cost per lb., .	3.24 cts.
	18.29 lbs. dressed weight gained; cost per lb., .	3.99 cts.
PERIOD II.	Cost of feed consumed during period, . .	$1.72
	45.00 lbs. live weight gained; cost per lb., .	3.82 cts.
	36.58 lbs. dressed weight gained; cost per lb., .	4.70 cts.
PERIOD III.	Cost of feed consumed during period, . .	$1.82
	35.50 lbs. live weight gained; cost per lb., . .	5.13 cts.
	28.86 lbs. dressed weight gained; cost per lb., .	6.31 cts.
PERIOD IV.	Cost of feed consumed during period, . .	$2.97
	52.00 lbs. live weight gained; cost per lb., .	5.71 cts.
	42.28 lbs. dressed weight gained; cost per lb., .	7.02 cts.

SUMMARY OF EXPERIMENT VIII.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Corn and Cob Meal (in lbs.).	Live weight gained during experiment (in lbs.).	Dressed weight gained during experiment (in lbs.).	Cost per lb. of Dressed Pork (cts.).
U, ...	50.26	185 25	49.68	62.10	182.59	163.00	122 82	5.44
V, ...	50.26	185.25	49.85	62.27	183.27	175.00	141.41	5.11
W, ...	50.26	185.25	49.68	62.10	182.59	164.50	132.83	5.44
X, ...	50.26	185.25	49.85	62.27	183.27	153.50	137.59	5.35
Y, ...	50 26	185.25	49.85	62.27	183.27	156.50	129.27	5.59
Z, ...	50.26	185.25	49.85	62.27	183.27	155.00	126.02	5.74
Total, . . .	301.56	1,111.50	298.76	373.28	1,098.26	967.50	799.94	-

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon, ...	$20.01
301.56 lbs. corn meal, at $23 00 per ton, ...	3.47
298.76 lbs. wheat bran, at $23.00 per ton, ...	3.44
373.28 lbs. gluten meal at $27.00 per ton, ...	5.04
1098.26 lbs. corn and cob meal, at $20.70 per ton, ...	11.42
	$43.38

Average cost of feed for production of 1 lb. dressed pork, 5.42 cts.

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Manurial Value of Feed consumed during Experiment.

Skim milk,	$8.85
Corn meal,	1.09
Wheat bran,	1.99
Gluten meal,	2.88
Corn and cob meal,	3.33
	$18.14

Manurial value of feed for production of 1 lb. of dressed pork, 2.27 cts.

Basis of Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used (1888).

	Per Cent.				
	Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Corn and Cob Meal.
Moisture,	13.08	91.00	11.14	9.77	13.69
Nitrogen (16½ cents per lb.),	1.80	.47	2.78	4.57	1.45
Phosphoric acid (6 cents per lb.),	.74	.22	1.86	.30	.69
Potassium oxide (4¼ cents per lb.),	.43	.21	1.07	.03	.55
Valuation per 2,000 lbs.,	$7.20	$1.99	$12.35	$15.46	$6.06

The net cost of feed consumed for the production of one pound of dressed pork, making a deduction of thirty per cent. of the fertilizing constituents contained in the feed, varies in the case of different animals from 3.52 cents to 4.00 cents per pound. In the case of the entire lot of pigs, it amounts to 3.83 cents per pound. As we sold our dressed pork at 7¾ cents per pound, we secured 3.92 cents per pound sold for investment, labor and profit.

It will be noticed that our estimates above are based on the ruling local market prices of the time when our late experiments were carried on. These prices differ from those adopted on earlier occasions. An intelligent comparison of our late financial results with those obtained in previous experiments can only be made by using corresponding values. The subsequent page contains a re-valuation of our late results, on the basis of market value used in all previous feeding experiments.

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SUMMARY OF EXPERIMENT BASED ON THE SAME COST OF FEED AND OF MANURIAL VALUE OF FEED CONSUMED AS USED IN PRECEDING EXPERIMENTS.

Total Cost of Feed consumed during Experiment.

1111.50 gals. skim milk, at 1.8 cents per gallon,	$20.01
301.56 lbs. corn meal, at $24.00 per ton,	3.62
298.76 lbs. wheat bran, at $22.50 per ton,	3.36
373.28 lbs. gluten meal, at $22.50 per ton,	4.20
1098.26 lbs. corn and cob meal, at $20.70 per ton,	11.42
	$42.61

Average cost of feed for production of 1 lb. dressed pork, 5.32 cts.

Manurial Value of Feed consumed during Experiment.

Skim milk,	$10.00
Corn meal,	1.20
Wheat bran,	2.02
Gluten meal,	3.26
Corn and cob meal,	3.33
	$19.81

Manurial value of feed for production of 1 lb. dressed pork, 2.48 cts.

The net cost of feed for the production of one pound of dressed pork, taking the entire lot of pigs into consideration, amounts to 3.69 cents. This result is the second best in our whole series of experiments. This fact becomes more significant when it is duly considered that the experiment (VIII.) was carried out during the winter season. The task of maintaining a desirable moderate temperature in the piggery during the entire trial becomes more difficult in winter than during any other season of the year. Low temperature requires more food for the support of respiration; the normal condition of the animal system is apt to be more seriously affected in various directions, and the gain in live weight suffers usually correspondingly in case of the same diet.

To confirm, if possible, our previously advanced conclusions still more, it was decided to repeat our mode of feeding with another lot of pigs during the latter part of spring and the summer season. An examination of our ninth experiment, which is described in a few subsequent pages, cannot fail to show that they are fully sustained.

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Analyses of Fodder Articles used in Experiment VIII.

SKIM MILK (AVERAGE).

	Per Cent.
Moisture at 100° C.,	91.00
Dry matter,	9.00
	100.00

Analysis of Dry Matter.

Crude ash,	6.67
" fat,	2.78
" protein (nitrogenous matter),	34.00
Non-nitrogenous extract matter,	56.55
	100.00

Nutritive ratio, 1 : 1.86.

CORN MEAL (AVERAGE).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	–	–	1 : 9.66
Dry matter,	86.92	1,738.40	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash,	1.66	33.20	–	–	
" cellulose,	3.49	69.80	23.73	34	
" fat,	4.97	99.40	75.54	76	
" protein (nitrogenous matter),	10.39	207.80	176.63	85	
Non-nitrogenous extract matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41		

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Wheat Bran (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.14	222.80	–	–	1 : 3.85
Dry matter,. . . .	88.86	1,777.20	–	–	
	100.00	2,000.00			
Analysis of dry matter.					
Crude ash, ...	6.59	131.80	–	–	
" cellulose, . . .	12.80	256.00	51.20	20	
" fat, ...	6.00	120.00	96.00	80	
" protein (nitrogenous matter), . .	17.72	354.40	311.87	88	
Non-nitrogenous extract matter, ...	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	–	

Gluten Meal (Average).

	Percentage composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.77	195.40	–	–	1 : 2.11
Dry matter,. . . .	90.23	1,804.60	–	–	
	100.00	2,000.00	–	–	
Analysis of dry matter.					
Crude ash, ...	.93	18.60	–	–	
" cellulose, . . .	4.60	92.00	31.28	34	
" fat, ...	6.63	132.60	100.78	76	
" protein (nitrogenous matter), . .	35.43	708.60	602.31	85	
Non-nitrogenous extract matter, ...	52.41	1,048.20	985.31	94	
	100.00	2,000.00	1,719.68	–	

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Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	13.69
Dry matter,	86.31
	100.00

Analysis of Dry Matter.

Crude ash,	1.68
" cellulose,	7.75
" fat,	3.67
" protein (nitrogenous matter),	9.13
Non-nitrogenous extract matter,	77.77
	100.00

Nutritive ratio, 1 : 8.8.

Ninth Experiment.

Six pigs of a mixed breed, weighing from seventeen to twenty-two pounds each, served in the experiment. The feeding began April 12, and closed August 8. The live weights of the animals at the time of killing varied from 185 to 203.5 pounds. Skim milk, corn meal, gluten meal and wheat bran furnished the ingredients of the diet. The mode of feeding was practically divided into three periods, with reference to the nutritive character of the feed, as follows: —

	Live Weight of Animal.	Nutritive Ratio.
I. Period,	20 to 90 lbs.,	1 digestible nitrogenous; 2.66 digestible non-nitrogenous constituents.
II. Period,	90 to 130 lbs.,	1 digestible nitrogenous; 3.62 digestible non-nitrogenous constituents.
III. Period,	130 to 200 lbs.,	1 digestible nitrogenous; 4.35 digestible non-nitrogenous constituents.

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Average of Daily Rations (Experiment IX.).

	Corn Meal (ounces).	Skim Milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).	Corn and Cob Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, . .	-	8	-	-	6.	I.	1:2.80
April 24 to May 1, . .	-	6	-	-	12.		
May 2 to May 14, . .	-	6	3.47	6.94	12.	II.	1:2.53
May 15 to May 28, . .	-	6	9.89	19.78	12.		
May 29 to June 4, . .	-	6	10.67	21.34	12.		
June 5 to June 22, . .	-	6	8.65	8.65	34.60	III.	1:3.83
June 23 to July 3, . .	-	6	9.86	9.86	39.44		
July 4 to July 9, . .	-	6	7.70	7.70	46.20	IV.	1:4.35
July 10 to July 25, . .	56.10	6	9.35	9.35	-		
July 26 to Aug. 8, . .	63.00	6	10.50	10.50	-		

[1.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1:2.80	21.50	50.00	1 7
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1:2.53	50.00	95.00	1 5
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1:3.62	95.00	140.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1:4.35	140.25	200.75	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter, . .	102.44 "
53.65 lbs. wheat bran, equal to dry matter, ...	46.94 "
70.38 lbs. gluten meal, equal to dry matter, ...	63.28 "
Total amount of dry matter, ...	429.19 lbs.

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Live weight of animal at beginning of experiment, . .	21.50 lbs.
Live weight of animal at time of killing, ...	200.75 "
Live weight gained during experiment, ...	179.25 "
Dressed weight at time of killing, ...	162.00 "
Loss in weight by dressing, ...	38.75 lbs., or 19.3 per cent.
Dressed weight gained during experiment, ...	144.65 lbs.

Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton, ...	$1 26
268.75 gals. skim milk, at 1.8 cents per gallon, ...	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton, ...	1 23
53.65 lbs. wheat bran, at $23.00 per ton, ...	62
70.38 lbs. gluten meal, at $27.00 per ton, ...	84
	$6 99

2.40 lbs. of dry matter fed yielded 1 lb. of live weight, and
2.97 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.83 cents.

[2.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	20.00	45.00	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	45.00	88.00	1 5
June 5 to July 3,	-	174.00	65.09	16.60	16.93	1 : 3.63	88.00	128.25	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	128.25	185.75	1 95

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter, ...	95.03 lbs.
675.00 qts. skim milk, equal to dry matter, ...	121.50 "
117.66 lbs. corn and cob meal, equal to dry matter, . .	101.55 "
53.38 lbs. wheat bran, equal to dry matter, ...	46.71 "
69.32 lbs. gluten meal, equal to dry matter, ...	62.33 "
Total amount of dry matter, ...	427.12 lbs.

Live weight of animal at beginning of experiment, . .	20.00 lbs.
Live weight of animal at time of killing, ...	185.75 "
Live weight gained during experiment, ...	165.75 "
Dressed weight at time of killing, ...	152.00 "
Loss in weight by dressing, ...	33.75 lbs., or 18.17 per cent.
Dressed weight gained during experiment, ...	135.63 lbs.

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Cost of Feed consumed during Experiment.

189.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
117.66 lbs. corn and cob meal, at $20.70 per ton,	1 22
53.38 lbs. wheat bran, at $23.00 per ton,	61
69.32 lbs. gluten meal, at $24.00 per ton,	83
	$6 96

2.58 lbs. dry matter fed yielded 1 lb. of live weight, and 3.17 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 5.13 cents.

[3.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.).	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	19.00	44.50	1 4
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	44.50	91.25	1 6
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1 : 3.62	91.25	182.00	1 6
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	182.00	196.25	1 11.5

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	19.00 lbs.
Live weight of animal at time of killing,	196.25 "
Live weight gained during experiment,	177.25 "
Dressed weight at time of killing,	159.00 "
Loss in weight by dressing,	37.25 lbs., or 18.98 per cent.
Dressed weight gained during experiment,	143.61 lbs.

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Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.49 lbs. of dry matter fed yielded 1 lb. of live weight, and
3.07 lbs. of dry matter yielded 1 lb. of dressed weight.
Cost of feed for production of 1 lb. of dressed pork, 4.97 cents.

[6.]

PERIODS.	Total amount of Corn Meal consumed during period (in lbs.).	Total amount of Skim Milk consumed during period (in qts.).	Total amount of Corn and Cob Meal consumed during period (in lbs.).	Total amount of Wheat Bran consumed during period (in lbs.).	Total amount of Gluten Meal consumed during period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of period (in lbs.)	Weight of Animal at end of period (in lbs.).	Gain in Weight per day during period.
1888.									lb. oz.
April 12 to May 1,	-	83.00	10.38	-	-	1 : 2.80	18.25	47.00	1 7
May 2 to June 4,	-	204.00	25.50	15.60	31.21	1 : 2.53	47.00	95.00	1 7
June 5 to July 3,	-	174.00	66.12	16.87	17.99	1 : 3.62	95.00	142.25	1 10
July 4 to Aug. 8,	109.97	214.00	16.69	21.18	21.18	1 : 4.35	142.25	203.50	1 11

Total Amount of Feed consumed from April 12 to August 8.

109.97 lbs. corn meal, equal to dry matter,	95.03 lbs.
675.00 qts. skim milk, equal to dry matter,	121.50 "
118.69 lbs. corn and cob meal, equal to dry matter,	102.44 "
53.65 lbs. wheat bran, equal to dry matter,	46.94 "
70.38 lbs. gluten meal, equal to dry matter,	63.28 "
Total amount of dry matter,	429.19 lbs.

Live weight of animal at beginning of experiment,	18.25 lbs.
Live weight of animal at time of killing,	203.50 "
Live weight gained during experiment,	185.25 "
Dressed weight at time of killing,	165.50 "
Loss in weight by dressing,	35 lbs., or 17.2 per cent.
Dressed weight gained during experiment,	153.39 lbs.

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Cost of Feed consumed during Experiment.

109.97 lbs. corn meal, at $23.00 per ton,	$1 26
168.75 gals. skim milk, at 1.8 cents per gallon,	3 04
118.69 lbs. corn and cob meal, at $20.70 per ton,	1 23
53.65 lbs. wheat bran, at $23.00 per ton,	62
70.38 lbs. gluten meal, at $24.00 per ton,	84
	$6 99

2.32 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.81 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.56 cents.

SUMMARY OF EXPERIMENT IX.

	Corn Meal (in lbs.).	Skim Milk (in gals.).	Corn and Cob Meal (in lbs.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during experiment (in lbs.).	Dressed Weight gained during experiment (in lbs.).	Cost per pound of Dressed Pork (cents).
1,	109.97	168.75	118.69	53.65	70.38	179.25	144.65	4.53
2,	109.97	168.75	117.66	53.38	69.32	165.75	135.63	5.13
3,	109.97	168.75	118.69	53.65	70.38	177.25	143.61	4.96
4,	109.97	168.75	118.69	53.65	70.38	171.75	140.36	4.96
5,	109.97	168.75	118.69	53.65	70.38	172.25	140.47	4.97
6,	109.97	168.75	118.69	53.65	70.38	185.25	153.39	4.56
	659.82	1,012.50	711.11	321.63	421.22	1,051.50	858.11	-

Total Cost of Feed consumed during the Above-stated Experiment.

659.82 lbs. corn meal, at $23.00 per ton,	$7 59
1,012.50 gals. skim milk, at 1.8 cents per gallon,	18 23
711.11 lbs. corn and cob meal, at $20.70 per ton,	7 36
321 63 lbs. wheat bran, at $23.00 per ton,	3 70
421.22 lbs. gluten meal, at $24.00 per ton,	5 05
	$41 93

Average cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

Manurial Value of Feed consumed during the Above Experiment.

Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.	Total.
$2 11	$8 29	$2 16	$2 01	$4 05	$18 62

Manurial value of feed for production of 1 lb. of dressed pork, 2.17 cents.

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SUMMARY OF EXPERIMENTS (II. TO IX. INCLUSIVE).

[Based on the same cost of feed and manurial valuation of feed consumed.]

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (in lbs.).	Cost of Feed per pound of Dressed Pork (in cents).	Manurial Value of Feed per pound of Dressed Pork (in cents).	Net Cost of Feed per pound of Dressed Pork after deducting thirty per cent. from Manurial Value (in cents).
II., ...	3.31	5.51	2.30	3.90
III., IV., V., ...	3.86	5.92	2.91	3.88
VI., ...	3.56	5.69	2.78	3.74
VII., ...	3.07	5.15	2.52	3.39
VIII., ...	3.27	5.32	2.48	3.58
IX., ...	3.00	4.89	2.30	3.27

Cost of Feed for the Production of One Pound of Live Weight during the Different Feeding Periods.

	Live Weight of Animal at close of feeding period (in lbs.).	Gain in Live Weight during period (in lbs.).	Cost of Feed for production of one pound of Live Weight (in cents).
1. I. Feeding Period, ...	50.00	28.50	1.72
II. " "	95.00	45.00	3.87
III. " "	140.25	45.25	4.13
IV. " "	200.75	60.50	4.78
2. I. Feeding Period, ...	45.00	25.00	1.96
II. " "	88.00	43.00	4.05
III. " "	128.25	40.25	4.57
IV. " "	185.75	57.50	5.03
3. I. Feeding Period, ...	44.50	25.50	1.92
II. " "	91.25	46.75	3.72
III. " "	132.00	40.75	4.59
IV. " "	196.25	64.25	4.50
4. I. Feeding Period, ...	42.00	25.00	1.96
II. " "	85.25	43.25	4.02
III. " "	126.00	40.75	4.59
IV. " "	188.75	62.75	4.61
5. I. Feeding Period, ...	45.00	23.50	2.09
II. " "	86.75	41.75	4.17
III. " "	129.50	42.75	4.38
IV. " "	193.75	64.25	4.50
6. I. Feeding Period, ...	47.00	28.75	1.70
II. " "	95.00	48.00	3.63
III. " "	142.25	47.25	3.96
IV. " "	203.50	61.25	4.72

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Analyses of Fodder Articles used in Experiment IX.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.59	271.80	–	–	1 : 9.56
Dry matter,	86.41	1,728.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.68	33.60	–	–	
" cellulose,	1.56	31.20	10.61	34	
" fat,	3.10	62.00	47.12	76	
" protein (nitrogenous matter),	10.42	208.40	177.14	85	
Non-nitrogenous extract matter,	83.24	1,664.80	1,564.91	94	
	100.00	2,000.00	1,799.78	–	

The analyses of corn and cob meal and of skim milk are the same as used in the preceding experiment.

WHEAT BRAN.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.50	250.00	–	–	1 : 3.86
Dry matter,	87.50	1,750.00	–	–	
	100.00	2,000.00			
Analysis of Dry Matter.					
Crude ash,	6.80	136.00	–	–	
" cellulose,	10.70	214.00	42.80	20	
" fat,	5.49	109.80	87.84	80	
" protein (nitrogenous matter),	17.79	355.80	313.10	88	
Non-nitrogenous extract matter,	59.22	1,184.40	947.52	80	
	100.00	2,000.00	1,391.26	–	

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GLUTEN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.09	201.80	–	–	1 : 1.82
Dry matter,	89.91	1,798.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.51	10.20	–	–	
" cellulose,	.86	17.20	5.85	34	
" fat,	4.86	97.20	73.87	76	
" protein (nitrogenous matter),	39.28	785.60	667.76	85	
Non-nitrogenous extract matter,	54.49	1,089.80	1,024.41	94	
	100.00	2,000.00	1,771.89	–	

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

	Per Cent.				
	Corn Meal.	Skim Milk.	Corn and Cob Meal.	Wheat Bran.	Gluten Meal.
Moisture,	13.59	–	13.69	12.50	10.09
Nitrogen,	1.60	.48	1.45	2.49	5.65
Phosphoric acid,	.662	.22	.688	2.54	.455
Potassium oxide,	.387	.21	.548	1.45	.059
Valuation per 2,000 lbs.,	$6 40	$2 02	$6 09	$12 50	$19 25

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ANALYSES OF FODDER ARTICLES.

Corn Fodder (Pride of the North).

	Per cent.
Moisture at 100° C.,	24.87
Dry matter,	75.13
	100.00

Analysis of Dry Matter.

Crude ash,	5.14
" cellulose,	22.26
" fat,	2.62
" protein (nitrogenous matter),	8.28
Non-nitrogenous extract matter,	61.70
	100.00

Fertilizing Constituents in Corn Fodder.

Moisture at 100° C.,	24.87
Nitrogen (16½ cts. per lb.),	.995
Phosphoric acid (6 cts. per lb.),	.201
Calcium oxide,	.310
Magnesium oxide,	.093
Potassium oxide (4¼ cts. per lb.),	1.465
Sodium oxide,	.794
Ferric oxide,	.026
Insoluble matter,	1.318
Valuation per 2,000 lbs.,	$4 77

Weight of stalk and ear (average),	8 oz.
" stalk (average),	3 oz.
" ear (average),	5 oz.

The above material was cut when the kernels began to glaze. Part of the crop was put into a silo. Both products have been used of late in our feeding experiments with milch cows.

Corn Cob (Pride of the North).

[Experiment Station, 1887.]

	Per cent.
Moisture at 100° C.,	24.76
Dry matter,	75.24
	100.00

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Analysis of Dry Matter.

	Per cent.
Crude ash,	1.75
" cellulose,	33.77
" fat,	.53
" protein (nitrogenous matter),	3.00
Non-nitrogenous extract matter,	60.95
	100.00

Fertilizing Constituents in Corn Cob.

Moisture at 100° C.,	24.76
Nitrogen (16½ cts. per lb.),	.36
Phosphoric acid (6 cts. per lb.),	.069
Calcium oxide,	.005
Magnesium oxide,	.008
Potassium oxide (4¼ cts. per lb.),	.512
Sodium oxide,	.265
Ferric oxide,	.006
Insoluble matter,	.267
Valuation per 2,000 lbs.,	$1 71

CORN AND COB MEAL (PRIDE OF THE NORTH).

[Experiment Station, 1887.]

	Per Cent.	
	I.	II.
Passed sieve, 144 meshes to square inch,	75.36	73 85
Moisture at 100° C.,	26.34	13.69
Dry matter,	73.66	86.31
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.64	1.68
" cellulose,	6.31	7.75
" fat,	3 36	3.67
" protein (nitrogenous matter),	7.82	9.13
Non-nitrogenous extract matter,	80.87	77.77
	100.00	100.00

Fertilizing Constituents in Corn and Cob Meal.

	Per cent.
Moisture at 100° C.,	26.34
Nitrogen (16½ cts. per lb.),	1.24
Phosphoric acid (6 cts. per lb.),	.587
Calcium oxide,	.095
Magnesium oxide,	.131
Potassium oxide (4¼ cts. per lb.),	.468
Sodium oxide,	.200
Ferric oxide,	.004
Insoluble matter,	.130
Valuation per 2,000 lbs.,	$5 19

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CORN ENSILAGE.

[Sent on from Marblehead, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	78.88	83.48
Dry matter,	21.12	16.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.32	4.30
" cellulose,	25.77	35.25
" fat,	3.27	3.33
" protein (nitrogenous matter),	8.94	6.91
Non-nitrogenous extract matter,	55.70	50.21
	100.00	100.00

Both samples of ensilage, it is stated, were planted and harvested at the same time; both had their kernels fully developed, just past the milky state, when they were put into a silo, Sept. 20 to 30, 1887. No. I. is from "Stowell's Evergreen Sweet," and No. II. from common "Southern White" corn.

Ensilage No. I. shows a larger percentage of nitrogenous and non-nitrogenous matter than No. II., yet it was of a decidedly inferior general state of preservation when received at our office. Whether this circumstance applies to the entire contents of each silo, or is merely of an accidental nature, we are unable to decide.

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Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.97	239.40	–	–	1 : 8.41
Dry matter,	88.03	1,760.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.48	29.60	–	–	
" cellulose,	1.83	36.60	12.44	34	
" fat,	4.81	96.20	73.11	76	
" protein (nitrogenous matter),	11.88	237.60	201.96	85	
Non-nitrogenous extract matter,	80.00	1,600.00	1,504.00	94	
	100.00	2,000.00	1,791.51	–	

Wheat Bran.

[Sent on from North Amherst, Mass.]

68.97 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.43	188.60	–	–	1 : 4.00
Dry matter,	90.57	1,811.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.27	125.40	–	–	
" cellulose,	12.98	259.60	51.92	20	
" fat,	4.36	87.20	69.76	80	
" protein (nitrogenous matter),	16.76	335.20	294.98	88	
Non-nitrogenous extract matter,	59.63	1,192.60	954.08	80	
	100.00	2,000.00	1,370.74	–	

The material is of a fair average composition.

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Fertilizing Constituents in Wheat Bran.

	Per cent.
Moisture at 100° C.,	9.43
Phosphoric acid (6 cts. per lb.),	2.67
Magnesium oxide,	.83
Calcium oxide,	.18
Potassium oxide (4¼ cts. per lb.),	1.51
Sodium oxide,	.15
Nitrogen (16½ cts. per lb.),	2.43
Insoluble matter,	.24
Valuation per 2,000 lbs.,	$12 50

WHEAT BRAN.
[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.25	185.00	–	–	1 : 4.26
Dry matter,	90.75	1,815.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.90	158.00	–	–	
" cellulose,	10.05	201.00	40.20	20	
" fat,	4.73	94.60	75.68	80	
" protein (nitrogenous matter),	16.12	322.40	283.71	88	
Non-nitrogenous extract matter,	61.20	1,224.00	979.20	80	
	100.00	2,000.00	1,378.79	–	

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Wheat Bran.

[Amherst Mills.]

67.50 per cent. passed screen 144 mesh to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.89	197.80	–	–	
Dry matter,	90.11	1,802.22	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.26	145.20	–	–	
" cellulose,	14.80	296.00	59.20	20	1 : 3.57
" fat,	5.22	104.40	83.52	80	
" protein (nitrogenous matter),	18.17	363.40	319.79	88	
Non-nitrogenous extract matter,	54.55	1,091.00	872.80	80	
	100.00	2,000.00	1,335.31	–	

Gluten Meal.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.50	190.00	–	–	
Dry matter,	90.50	1,810.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.08	21.60	–	–	
" cellulose,	4.74	94.80	32.23	34	1 : 1.95
" fat,	3.92	78.40	59.58	76	
" protein (nitrogenous matter),	36.19	723.80	615.23	85	
Non-nitrogenous extract matter,	54.07	1,081.40	1,016.52	94	
	100.00	2,000.00	1,723.56	–	

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GLUTEN MEAL.

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.10	222.00	–	–	
Dry matter,	88.90	1,778.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.55	11.00	–	–	1 : 2.24
" cellulose,	.91	18.20	6.19	34	
" fat,	6.13	122.60	93.18	76	
" protein (nitrogenous matter),	34.79	695.80	591.43	85	
Non-nitrogenous extract matter,	57.62	1,152.40	1,083.26	94	
	100.00	2,000.00	1,774.06	–	

ROWEN.

[Grown at the Experiment Station, 1887. Contained a liberal admixture of clover.]

	Per cent.
Moisture at 100° C.,	8.84
Dry matter,	91.16
	100.00
Analysis of Dry Matter.	
Crude ash,	10.50
" cellulose,	29.46
" fat,	3.05
" protein (nitrogenous matter),	13.20
Non-nitrogenous extract matter,	13.79
	100.00
Fertilizing Constituents of the above Rowen.	
Moisture at 100° C.,	8.840
Nitrogen (16½ cts. per lb.),	1.930
Phosphoric acid (6 cts. per lb.),	.364
Potassium oxide (4¼ cts. per lb.),	2.860
Calcium oxide,	.853
Magnesium oxide,	.197
Sodium oxide,	.122
Ferric oxide,	.057
Insoluble matter,	2.178
Valuation per 2,000 lbs.,	$9 24

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PROVENDER.

[From Amherst Mill.]

	Per cent.
Moisture at 100° C.,	9.40
Dry matter,	90.60
	100.00

Analysis of Dry Matter.

Crude ash,	3.42
" cellulose,	11.52
" fat,	5.76
" protein (nitrogenous matter),	14.35
Non-nitrogenous extract matter,	64.95
	100.00

Nutritive ratio, 1 : 7.56.

This article is, according to statement, a mixture of 450 pounds of corn, 125 pounds of oats, and 100 pounds of wheat bran.

GROUND OAT FEED.

[Sent on from Salem, Mass.]

	Per cent.
Moisture at 100° C.,	8.92
Dry matter,	91.08
	100.00

Analysis of Dry Matter.

Crude ash,	3.52
" cellulose,	8.78
" fat,	8.34
" protein (nitrogenous matter),	18.66
Non-nitrogenous extract matter,	60.69
	100.00

The article is evidently a compound containing admixtures which are richer in nitrogenous matter and fat than oats. A mere analysis of a compound commercial fodder article is only of interest to the practical farmer when the amount and kind of ingredients which serve in its preparation are well known. It is not safe, as a rule, to invest to any extent in a compound commercial fodder article without feeling well satisfied concerning the character of its various ingredients.

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Spent Brewer's Grain.

72.63 per cent. passed through mesh 144 to square inch.

	Per cent.
Moisture at 100° C.,	6.98
Dry matter,	93.02
	100.00

Analysis of Dry Matter.

Crude ash,	6.15
" cellulose,	15.90
" fat,	1.95
" protein (nitrogenous matter),	20.49
Non-nitrogenous extract matter,	55.51
	100.00

Fertilising Constituents of Spent Brewer's Grain.

Moisture at 100° C.,	6.98
Nitrogen (16½ cts. per lb.),	3.05
Phosphoric acid (6 cts. per lb.),	1.26
Potassium oxide (4¼ cts. per lb.),	1.552
Calcium oxide,	.296
Magnesium oxide,	.286
Sodium oxide,	.347
Ferric oxide,	.159
Insoluble matter,	1.770
Valuation per 2,000 lbs.,	$12 88

The material is of a fair quality as far as composition is concerned.

Cotton Hulls.

[I. and II. sent on from Boston, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.17	11.45
Dry matter,	89.83	88.85
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	2.75	3.38
" cellulose,	51.40	40.24
" fat,	2.36	4.27
" protein (nitrogenous matter),	4.90	5.36
Non-nitrogenous extract matter,	38.59	46.75
	100.00	100.00

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Fertilising Constituents of Cotton Hulls.

[I. and II. sent on from Boston (same as above); III. sent on from Memphis, Tenn.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.17	11.45	8.76
Phosphoric acid,	.14	.28	.18
Magnesium oxide,	.23	.29	.25
Calcium oxide,	.13	.20	.22
Potassium oxide,	1.12	1.06	1.07
Nitrogen,	.77	.76	.74
Insoluble matter,	.06	.003	.11
Valuation per 2,000 lbs.,	$3 66	$3 75	$3 57

Cotton-seed Meal.

[Sent on from North Amherst, Mass.]

68.34 per cent. passed sieve 144 mesh to square inch.

	Per cent.
Moisture at 100° C.,	6.84
Dry matter,	93.16
	100.00

Analysis of Dry Matter.

Crude ash,	7.06
" cellulose,	10.83
" fat,	13.02
" protein (nitrogenous matter),	40.13
Non-nitrogenous extract matter,	28.96
	100.00

A fair sample of its kind.

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FIELD EXPERIMENTS.

I. Field A. Fodder Corn raised with Single Articles of Plant Food.

II. Field B. Fodder Crops raised with and without Complete Manure.

III. Field C. Experiments with Fodder Crops for Green Fodder.

IV. Experiments with Potatoes; and Paper on Potato Scab, by Prof. James E. Humphrey.

V. Experiments with Root Crops.

VI. Notes on Miscellaneous Field Work.

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FIELD EXPERIMENTS.

[Field A.]

I. Fodder Corn raised upon Worn-out Meadow Lands partly fertilized with One or Two Special Articles of Plant Food, partly without the Use of any Manurial Matter.

The observations recorded below extend already over a period of five years.* The field selected for the experiment was utilized for a series of years previous to 1882 as a meadow for the production of hay. The annual yield of that crop had suffered at that time a serious decline in quantity and quality. During the spring of 1883 it was planted with corn for the production of fodder corn, without the use of any manurial matter.

The same course of planting and of general treatment was carried out during the year 1884. The corn fodder raised in that year left no doubt about the serious exhaustion of the soil, as far as its fitness for a further successful cultivation of corn fodder was concerned, for the entire yield of that crop amounted only to 5,040 pounds per acre, with a moisture of thirty per cent. The soil had evidently reached a condition which promised to prove favorable for a special investigation, as far as the extent and the particular character of its exhaustion on plant food was concerned, whether the failure of the crop was due to a general exhaustion of

* For details, see preceding reports, 1883, 1884, 1885, 1886, 1887.

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essential articles of plant food, or to that of any particular one of them.

As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it seemed but natural that a soil which originally did not contain much more of available potash than of available phosphoric acid must become unproductive, as far as these crops are concerned, before the latter is exhausted. It is not less evident that a system of manuring, devised with reference to this circumstance alone, can prevent an early decline of remunerative crops in the majority of cases.

The recognized importance of both — grasses and fodder corn — in our present system of general farm management has served as the principal inducement to begin our field experiments at the Experiment Station with a practical illustration of the particular serious changes which a close rotation of these crops produces in the existing soil resources of plant food, wherever the adopted system of manuring does not provide for a periodical return of fertilizing substances, with reference to the kind and to the amount of each of them carried off by the crop.

The land set apart for the experiment consists of ten adjoining plats, one-tenth of an acre each in size. The plats are five feet apart; the grounds between them are kept free from any growth, and receive no fertilizing ingredients of any description. The entire field is surrounded by a tile drain, and each plat has a separate one through its centre. This terminates at its east end in a well, which is connected with the surrounding drain.

The systematic treatment of the various plats began in May, 1885. All were ploughed, year after year, at the same time and in the same manner, — in autumn after harvesting and in spring before manuring and planting Plats 1, 3, 5, 7, 9 and 10 received annually for three succeeding years, 1885, 1886 and 1887, an addition of a definite amount of either phosphoric acid or of a nitrogen compound or of a potash compound; while plats 2, 4, 6 and 8 received no

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manurial matter during that period. All, except plat 6, were planted during the above-stated three succeeding years with the same variety of corn (Clark). Plat 6 received during that time no fertilizing material; it was ploughed and worked with the cultivator in the same manner and at the same time when the other plats were thus treated; it was kept clear, as far as practicable, from every kind of vegetable growth (black fallow).

The details of the work and of the annual results of the course pursued in the management of the experiment have been described in the preceding annual report. The subsequent summary may suffice here to record the principal facts brought out before the beginning of the present year (1888).

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FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886 and 1887, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.			YIELD OF DRY FODDER CORN.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
PLAT 1, .	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
PLAT 2, .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
PLAT 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
PLAT 4, .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
PLAT 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
PLAT 6, .	Fallow, ...	Fallow, ...	Fallow, ...	-	-	-
PLAT 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), . .	280	255	730
PLAT 8, .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
PLAT 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
PLAT 10, .	48½ lbs. of potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

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A careful study of these results shows that neither phosphoric acid nor any form of nitrogen, when applied each by itself, even in exceptionally large proportions, has produced a material change in the annual yield, as compared with that obtained on unfertilized plats. The application of potash compounds alone shows in every instance a decided increase in the crop. The annual yield was increased by its use during the first two years to twice the amount of that previous to its special application.

1888. — The original plan of the experiment has not been altered materially during the past season. The principal aim of our investigation has been the same as during the three preceding years; namely, to study the direction and the degree of exhaustion on plant food of field "A" during the progress of our investigation.

The results of the past season (1888) confirm the conclusion presented in our previous annual report, 1887. An exceptional deficiency of the soil on available potash, produced by continued close rotation of grasses and corn fodder, without any substantial provision for an exceptionally large consumption of potash, proves still the first cause of a reduced annual yield of corn fodder.

The exhaustion on available plant food assumes, however, as might be expected, a more general character as years pass on. This fact shows itself plainly in a gradual falling off of the annual yield on plat 9, where a liberal amount of potash as the sole fertilizing material exerted in preceding years a marked beneficial influence on the annual yield. The same circumstance causes evidently the lower yield upon those plats (1 and 7) which received a liberal manuring with potash compounds two years later, and, after a repeated application of each, phosphoric acid or nitrogen had failed to improve the annual yield.

A manuring for three successive years with potash alone has sufficed in our case to terminate its beneficial effect on the natural productiveness of the soil, as far as the corn crop is concerned. More complete manures are required to restore a desirable degree of fertility of the soil.

The result obtained on plat 6 deserves a particular notice. This plat had been used, in common with the entire area

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occupied by our experiment, for two years in succession,—1883 and 1884,—for the production of fodder corn without the use of any manurial matter. The degree of exhaustion of the entire field was very marked and practically uniform. During the spring of 1885, when all other plats were planted with the same variety of corn, plat 6 was ploughed and harrowed like the remainder, but not planted with corn; it was assigned to the task of ascertaining the effects of "black fallow" on the soil under treatment. It seemed of interest, in connection with our inquiry, to illustrate the influence of mere atmospheric agencies on the future productiveness of our field. For this purpose, during the years 1885, 1886 and 1887, the plat was ploughed, harrowed and treated with the cultivator in the same manner and at the same time as the remaining plats. During that entire period no manurial matter of any description was applied. The appearance of every description of vegetation was, as far as practicable, prevented by a timely use of the cultivator.

At the beginning of the past season, after having produced no crop for three succeeding years, it was prepared in the same way and at the same time as the other plats for the planting of one and the same variety of corn. No manurial matter was on that occasion applied to plat 6. The date of planting the corn, and the subsequent treatment of the crop to the time of harvesting, was the same in all cases. The yield of fodder corn upon plat 6 was the third lowest in the scale including all plats; *i. e.*, 1,930 pounds per acre. It was also the poorest-looking crop upon field "A" during the larger portion of the season. The result shows, in a very striking manner, that the growing of plants does materially assist in rendering available the inherent mineral plant food of the soil. The growth of three years, although in our case exceptionally small, was lost to us. Our observation in this connection confirms the results of more recent careful investigations into older systems of agricultural practice. Black fallow, as a rule, does not materially benefit the productiveness of an exhausted soil, and ought to be discouraged, therefore, from a mere financial point, at present rates of rent.

The subsequent more detailed description of the field

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work carried on during the past season, as well as the conditions of the crop at different stages of growth, upon different plats into which field "A" has been subdivided, will enable all parties interested in the experiment to draw their own conclusions regarding its teachings.

The entire field was ploughed twice, as in previous years,—in autumn, a short time after harvesting the crop, and early in the succeeding spring. The fertilizing materials, single or compound, wherever used, were applied broadcast, and slightly harrowed under some time before planting.

Plat 1. Received 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 2. 50 pounds of nitrate of soda (7–8 pounds of nitrogen).

Plat 3. 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

Plat 4. Nothing.

Plat 5. 97 pounds of magnesia sulphate.

Plat 6. Nothing.

Plat 7. 50 pounds of muriate of potash (25 pounds of potassium oxide).

Plat 8. 50 pounds of sulphate of ammonia (10 pounds of nitrogen).

Plat 9. 50 pounds of muriate of potash (25 pounds of potassium oxide.

Plat 10. 97 pounds of sulphate of potash and magnesia (25 pounds of potassium oxide); 100 pounds of dissolved bone-black (16–17 pounds of soluble phosphoric acid).

The corn (Clark) was planted in drills, May 29. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with six to eight seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised.

The young plants appeared above ground quite uniformly, June 5. They soon showed, however, marked differences in regard to the rate of growth upon different plats, and presented, as the season advanced, more or less striking differences in their general appearance.

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HEIGHT OF CORN ON PLATS, IN INCHES (1888).

	June 27.	July 5.	July 12.	July 20.	July 27.	Aug. 3.	Aug. 10.	Aug. 17.	Aug. 24.
Plat 1, . . .	8	8½	12	15	20	27	45	58	72
Plat 2, . . .	7	7½	9	11	15	18	29	40	62
Plat 3, . . .	7	9	12½	14½	19	22	34	41	45
Plat 4, . . .	4½	5½	7	8½	12	14	20	25	35
Plat 5, . . .	8	10	13½	17	23	30	45	60	72
Plat 6, . . .	5	5½	6	6½	7	9	14	25	32
Plat 7, . . .	8	10	15	19	26	36	56	67	74
Plat 8, . . .	5	8	8½	10	13	15	19	25	29
Plat 9, . . .	7	9	12	15	19	33	36	55	63
Plat 10, . . .	9	13	17	20	30	49	72	85	84

A change in the color of the plants was first noticed at the beginning of July upon plat 6, and subsequently in those upon plat 8. Tassels appeared at about the same time on plats 1, 2, 3, 5, 7 and 9, and about three days later on plats 4, 6 and 8. An examination of the plants at the time of cutting, September 14, showed that those raised upon plats 2, 3, 4, 6 and 8 had either no ears or but a few imperfect ones, while those from plats 1, 5, 7 and 9 had more. Plat 10 had from two to three times as many as either of the last mentioned. The majority of the plats, with the exception of plat 10, had produced only small and imperfect ears.

The following tabular statement contains the exact results, as far as the character of the crop is concerned: —

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	Height of Plants When Cut.	Weight of Stover.	Weight of Ears.
Plat 1, ...	72 inches.	559 lbs.	58 lbs.
Plat 2, ...	62 "	280 "	23 "
Plat 3, ...	45 "	150 "	0 "
Plat 4, ...	35 "	113 "	1 "
Plat 5, ...	72 "	510 "	54 "
Plat 6, ...	32 "	193 "	0 "
Plat 7, ...	74 "	626 "	50 "
Plat 8, ...	29 "	141 "	5 "
Plat 9, ...	63 "	487 "	66 "
Plat 10, ...	84 "	607 "	130 "

The experiment will be continued, with some modifications, for another year. As the condition of the soil in field "A" (see next page) becomes from year to year better known, its fitness for investigations of a similar character increases as time advances.

The photographic illustrations accompanying this chapter represent some of the most striking features noticeable in the growth of these plats. They illustrate in particular the striking influence of potash on the annual yield, and show the disadvantages of black fallow on the productiveness of farm lands.

The annual yield of crops of dry corn fodder is stated with reference to the same moisture, 48 per cent.

The crops raised during the years 1886, 1887 and 1888, on plats 1, 2, 6, 7 and 9, have served for our illustrations.

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FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887 and 1888, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.		YIELD OF DRY FODDER CORN.		YIELD PER ACRE.
	1887.	1888.	1887.	1888.	1888.
			Lbs.	Lbs.	Lbs.
PLAT 1, . .	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen), and 50 lbs. muriate potash (= 25 lbs. potassium oxide).	50 lbs. muriate potash (= 25 lbs. potassium oxide), ...	720	617	6,170
PLAT 2, . .	Nothing, ...	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen), .	165	303	3,030
PLAT 3, . .	60 lbs. dried blood (= 7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	240	150	1,500
PLAT 4, . .	Nothing, ...	Nothing, ...	130	114	1,140
PLAT 5, . .	50 lbs. ammonium sulphate (= 10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. sulphate magnesia, ...	635	564	5,640
PLAT 6, . .	Fallow, ...	Nothing, ...	-	193	1,930
PLAT 7, . .	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	730	676	6,760
PLAT 8, . .	Nothing, ...	50 lbs. sulphate of ammonia (= 10 lbs. nitrogen),	165	146	1,460
PLAT 9, . .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), .	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	655	553	5,530
PLAT 10, . .	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), .	940	737	7,370

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EXPERIMENTS WITH CORN FODDER. FIELD A. PLAT I.
(One-tenth of an acre.)

1886. 50 lbs. Sodium Nitrate (=7 to 8 lbs. nitrogen).
Yield of Dry Corn Fodder. 430 lbs.

1887. 50 lbs. Sodium Nitrate (=7 to 8 lbs. Nitrogen) and .50 lbs. Muriate of Potash (=25 lbs. potassium oxide).
Yield of Dry Corn Fodder, 720 lbs.

1888. 50 lbs. Muriate of Potash (=25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder, 617 lbs.

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1886. No Fertilizer.
Yield of Dry Corn Fodder, 250 lbs.

1887. No Fertilizer.
Yield of Dry Corn Fodder, 165 lbs.

1888. 50 lbs. Sodium Nitrate (= 7 to 8 lbs Nitrogen).

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A field with complete manure, consisting of Barn-yard manure and potash Salts.

Yield of Dry Corn Fodder, 2800 lbs.

Plat 6. 1888. Was kept free from any vegetation from 1885 to 1888; and planted in 1888 with corn without receiving any manurial matter.

Yield of Dry Corn Fodder, 193 lbs.

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EXPERIMENTS WITH CORN FODDER. FIELD A. PLAT 7.

1886. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid). Yield of Dry Corn Fodder. 255 lbs.

1887. 100 lbs. Dissolved Bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide). Yield of Dry Corn Fodder. 730 lbs.

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1888. 50 lbs. Muriate of Potash (= 25 lbs. of Potassium Oxide)

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1886. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 840 lbs.

1887. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 655 lbs.

1888. 50 lbs. Muriate of Potash (= 25 lbs. Potassium Oxide).
Yield of Dry Corn Fodder. 553 lbs

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II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops.

[Field "B."]

The field assigned to the above-stated inquiry is located west of field "A," and has been used, like the latter, for several years previous to the establishment of the Experiment Station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. During the spring of 1883 it was ploughed and prepared for raising corn fodder. This crop was raised for one year in drills, and without the aid of any manurial matter. The previous thorough mechanical treatment of the soil, as well as its impoverished condition, was considered favorable for the contemplated work. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. The fertilizer has been applied at an early date each spring, either broadcast or between the rows, as circumstances admitted. It was in each case subsequently slightly harrowed under. Since 1885, all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and in the case of grasses, two feet. The space between the different plats measured five feet; it has received thus far no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 are fertilized annually; plats 12, 14, 16, 18 and 20 have received thus far no fertilizer. The single plats are either occupied by one variety of plants or by two; in some instances several plats are used for one and the same crop. Corn and various prominent varieties of meadow grasses and of leguminous plants have thus far been selected for observation.

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The details of the work carried on upon field "B" are from year to year recorded in the annual report of the Station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins and the reports of the succeeding year. These analyses may claim a special interest, as they are made of a variety of fodder crops, raised, as far as practicable, under corresponding circumstances with reference to climate, to soil, to system of manuring, to the adopted modes of cultivation, of harvesting and of analyzing. In making this statement, I do not mean to imply that our local conditions of climate and of soil are in every instance the most favorable ones to enable the various crops here on trial to attain in all cases the highest possible development. This qualification of our results applies with more or less propriety to some varieties of grasses as well as of leguminous plants.

The subsequent tabular record of the crops raised upon the different plats of field "B" since 1884 may assist in a desirable understanding of its past history and its condition at the beginning of the season of 1888. The single plats are, since 1886, each 175 feet long and 33 feet wide.

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STATEMENT OF CROPS RAISED ON FIELD "B."

PLATS.	1884.	1885.	1886.	1887.
PLAT 11 (fertilized),	Orchard grass (*Dactylis glomerata*), Meadow fescue (*Festuca pratensis*),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
PLAT 12 (unfertilized),	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Orchard grass, Meadow fescue,	Corn.
PLAT 13 (fertilized),	Hungarian grass (*Panicum Germanicum*), Pearl millet (*Penicillaria spicata*),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).
PLAT 14 (unfertilized),	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Hungarian grass, Pearl millet,	Italian rye-grass. English rye-grass.
PLAT 15 (fertilized),	Timothy (*Pleum pratense*), Red-top (*Agrostis vulgaris*),	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
PLAT 16 (unfertilized),	Timothy, Red-top,	Timothy, Red-top,	Timothy, Red-top,	Five varieties Southern cow-pea.
PLAT 17 (fertilized),	Corn (variety, Clark),	Corn,	Corn,	Meadow fescue.
PLAT 18 (unfertilized),	Corn,	Corn,	Corn,	Alsike clover (*Trifolium hybridum*). Medium red clover (*Trifolium pratense*).
PLAT 19 (fertilized),	Corn,	Corn,	Corn,	Alsike clover. Medium red clover.
PLAT 20 (unfertilized),	Corn,	Corn,	Corn,	Mammoth red clover (*Trifolium medium*). Alfalfa or lucerne (*Medicago sativa*).
PLAT 21 (fertilized),	Corn,	Corn,	Corn,	Mammoth red clover. Alfalfa.

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1888. — At the beginning of the season but few changes became necessary in the management of the field; for, plats 13, 14, 17, 18, 19, 20 and 21 being still occupied by a perennial vegetation, only plats 11, 12, 15 and 16 required particular attention in that direction. It was decided to add the Kentucky blue-grass (*Festuca pratensis*) and the Soja bean (*Soja hispida*) to our list of prominent crops on trial upon field "B."

Plats 11 and 12 were seeded down, in drills two feet apart, with Kentucky blue-grass; and plats 15 and 16 with Soja beans, in rows three feet and three inches apart, to correspond with the rule adopted for grasses and leguminous plants. In both instances one plat was fertilized in the same way as heretofore, with fine-ground bones and muriate of potash (11 and 15), and the other two (12 and 16) received no fertilizer. The Kentucky blue-grass was seeded down rather late, May 24, and the Soja beans May 18. The mechanical condition of the soil was in both cases very satisfactory for the work.

Those plats which were still occupied by perennial plants, planted in preceding years, were treated between the rows at an early date with the cultivator, and subsequently the weeds and foreign growth in the rows removed with the hoe and the hand. Plats 13, 17, 19 and 21 received at the same time their annual supply of manure, consisting of fine-ground bones and muriate of potash. Plats 14, 16, 18 and 20 received none.

As the plats were 175 feet long and 33 feet wide, equal to an area of 5,775 square feet, each received a mixture of 80 pounds of ground bones and 27 pounds of muriate of potash.

The subsequent enumeration of crops raised upon field "B," during the years 1887 and 1888, shows the change made in crops at the beginning of the past season.

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	1887.	1888.
Plat No. 11 (fertilized), .	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 12 (unfertilized),	Corn (Clark variety).	Kentucky blue-grass.
Plat No. 13 (fertilized), .	Italian rye-grass (*Lolium Italicum*). English rye-grass (*Lolium perenne*).	Italian rye-grass. English rye-grass.
Plat No. 14 (unfertilized),	Italian rye-grass. English rye-grass.	Italian rye-grass. English rye-grass.
Plat No. 15 (fertilized), .	Five varieties Southern cow-pea.	Soja bean.
Plat No. 16 (unfertilized),	Five varieties Southern cow-pea.	Soja bean.
Plat No. 17 (fertilized), .	Meadow fescue (*Festuca pratensis*).	Meadow fescue.
Plat No. 18 (unfertilized),	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 19 (fertilized), .	Alsike clover. Medium red clover.	Alsike clover. Medium red clover.
Plat No. 20 (unfertilized),	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.
Plat No. 21 (fertilized), .	Mammoth red clover. Alfalfa (lucerne).	Mammoth red clover. Alfalfa.

The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Perennial rye-grass, plat 14 (unfertilized), was almost entirely winter-killed; while upon plat 13 (fertilized) a much less serious effect could be noticed.

Italian rye-grass looked decidedly better preserved in both instances than the perennial rye-grass.

Meadow fescue, plat 17 (fertilized), appeared remarkably vigorous, and retained the lead for the entire season, as far as the varieties of grasses on trial are concerned.

Alsike clover was seriously winter-killed upon the unfertilized plat 18, while upon the fertilized plat 19 it was very well preserved.

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Medium red clover appeared in fair condition upon plat 18 (unfertilized), yet fell behind the alsike clover on plat 19 (fertilized).

Alfalfa and *mammoth clover*, on plats 20 and 21, presented the same features in their growth as was noticed with reference to alsike clover and medium clover.

The weight of the hay obtained from the first cut of each kind of crop, when well advanced in blooming, gives a fair representation of their general character and condition at the time of harvesting. The yield is in every instance stated with reference to an entire plat (175×33 feet), in case of fertilized as well as unfertilized ones.

GRASSES.

	English Rye-Grass, cut July 5, 1888.	Italian Rye-Grass, cut July 5, 1888.	Meadow Fescue, cut July 2, 1888.
Fertilized plat, . .	300 lbs.	260 lbs.	700 lbs.
Unfertilized plat, . .	90 "	105 "	No plat.

LEGUMINOUS PLANTS.

	Medium Red Clover, cut July 5, 1888.	Alsike Clover, cut July 5, 1888.	Mammoth Red Clover, cut July 5, 1888.	Alfalfa, cut July 5, 1888.
Fertilized plat, . .	690 lbs.	490 lbs.	460 lbs.	150 lbs.
Unfertilized plat, .	250 "	70 "	20 "	50 "

SOJA BEAN (GREEN).

Cut Aug. 30, 1888.

Fertilized plat, ...	2,080 lbs.
Unfertilized plat, ...	1,560 "

(The crop was put into a silo Aug. 30, 1888.)

The Soja bean has been raised during the past season in different parts of the field, to serve for ensilage. The investigation of this valuable plant is not yet finished, and a detailed description has been reserved for a future date.

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As the cultivation in rows is an exceptional one as far as meadow grasses and clovers are concerned, no attempt has been made to state their yield per acre. The principal aim of the experiment on field "B" consists, as has been stated above, in securing suitable samples of each crop on trial, for the purpose of ascertaining the influence of stage of growth and of a different degree of fertility of the soil on their composition. Sufficient material has been collected of every crop stated above, and the results of a chemical analysis of each will be published from time to time as the work advances.

The analyses of alfalfa and of alsike clover of the first year's growth (1887) have been already published in the annual report for that year; also analyses of orchard grass, red-top, meadow fescue and timothy. (See pages 125–132.)

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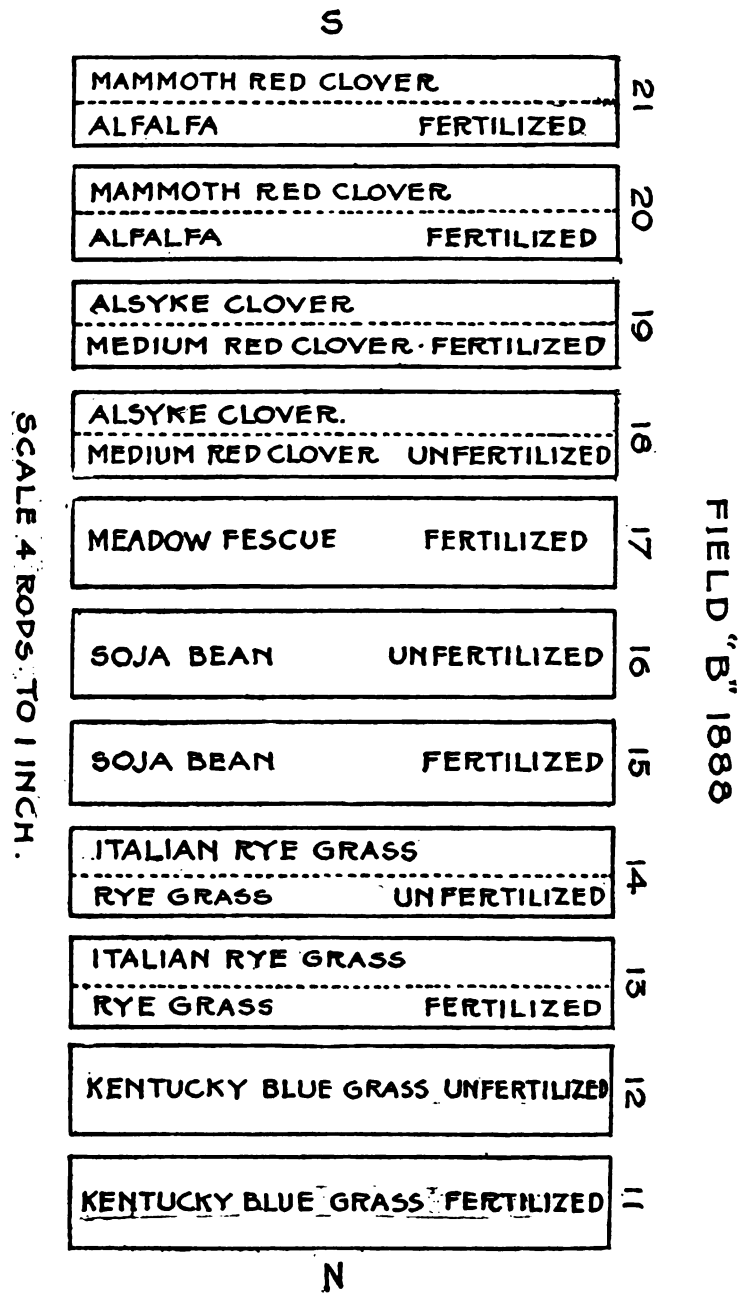

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III. Experiments with Fodder Crops for Green Fodder.

[Field "C."]

In a discourse on fodder supply for dairy cows, in the preceding annual report, pages 89, 90, the following statement was made: —

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at a time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotations, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and, for this reason, largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

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Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder plants may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1.	Leguminous plants, clover, vetch, etc., . .	1 : 2.2 to 1 : 4.5
2.	Grasses, ...	1 : 5.0 to 1 : 8.0
3.	Green corn, roots and tubers, ...	1 : 6.0 to 1 : 15.0

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

Believing in the correctness of the previous remarks, it has been one of the aims of the manager of the Station to experiment with various new fodder crops, to ascertain their adaptation to our climate and soil, and their fitness for the support of the dairy industry at a period of the season when good hay is scarce, and when the green fodder corn has not yet reached a desirable condition to do its best.

Some, as the vetch, Southern cow-pea and serradella, have been cultivated for several years past on a comparatively large scale, with marked success. They yielded a

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liberal amount of green fodder from the beginning of June to the beginning of October. Their good services as green fodder for milch cows during that period have been described in the last annual report (1887, pages 35–48). Similar results have been obtained in this direction during the past season. The details of the feeding experiment form a part of this report.

The observations with reputed fodder crops have been extended during the past year; most of them were, however, raised on a small scale, to ascertain merely their general character and their particular degree of adaptation to our climate and soil, and to secure material for analysis, to compare their relative proportions of essential nutritive constituents.

The fact, as has been stated before, that all these crops are raised under corresponding conditions, as far as climate, soil, modes of cultivation and of fertilization and particular stages of growth are concerned, imparts to the results the claim of an exceptional value to decide judiciously their comparative merits.

1888.—Field "C" comprises at present an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passage-way three feet wide.

The northern half of the field is 70 feet wide and 328 feet long; the southern half is of the same length, but 110 feet wide.

The latter is again sub-divided into three equal plats, each 111 × 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and of oats (variety, western). The middle division was planted the same day with serradella, and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart. The northern half of field "C" was occupied by a series of crops in rows,

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running from south to north, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning on the east end: —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.
Teosinte (*Euchlæna euxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture.

Vetch and Oats. — Twenty-five pounds of vetch and fifty pounds of oats were seeded broadcast May 8. The oats appeared above ground May 15, the vetch on May 17. The oats began to head out and the vetch to bloom June 30. Both crops had reached a height of 28 inches July 5, and of 32 inches July 12. The feeding of the crop began July 7 and terminated July 23. The total yield of the green crop amounted to 5,276 pounds, or 8.53 tons, per acre.

Southern cow-peas were seeded in rows, three feet and three inches apart, May 14. They appeared above ground May 28. The plants were six inches high June 27; twelve inches high July 12; and twenty inches high August 3. They began to fill out the space between the rows August 10; bloomed August 17, and formed pods August 23. The feeding of the crop commenced September 4, and was finished September 15. The crop had suffered somewhat from frost September 7. The total yield amounted to 4,050 pounds, or 7.36 tons, per acre.

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Serradella was planted in rows, three feet three inches apart, May 14. The young plants appeared above ground May 26. They had reached a height of six inches July 5; began blooming July 12, and measured eleven inches, when a blight made its appearance on the leaves, which ultimately destroyed the crop to such an extent that no part of it was fed. The grounds occupied by the serradella had been used during the preceding season for the cultivation of different varieties of wheat, which seriously suffered from fungoid growth. The exceptionally wet season most likely contributed also towards the failure of the crop.

The early frost, September 7, terminated prematurely the observations on Chinese sugar cane, early orange cane and early amber cane.

Teosinte, pop-corn, flour corn, melilotus, sulla, hairy vetch and lotus, have been sampled for analysis.

The perennial varieties of leguminous plants are left in the field for observations during the coming season, when their special agricultural merits will be discussed.

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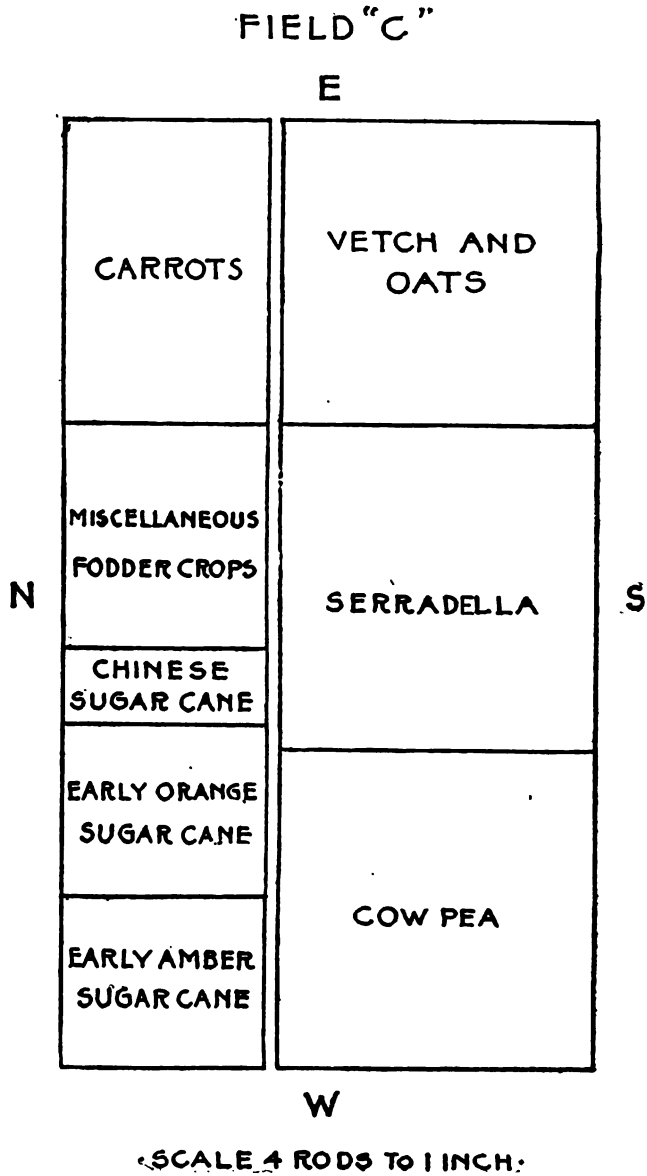

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IV. Experiments with Potatoes.

The experiments reported in this connection are continuations of those described under the same heading in our last annual report.

One of the experiments has been carried on upon the same portion of field "D" since 1884. It was originally instituted for the purpose of studying the effects of high-grade German potash salts, muriate of potash and potash magnesia sulphate, as the main potash source of plant food, on the quantity and the quality of potatoes raised by their assistance.

The second one, observations with scabby potatoes, owes its origin to the interest created by some observations made in connection with the former; it was carried on, for important reasons, upon a different part of the farm.

A. Observations upon Field "D."

[Variety: Beauty of Hebron.]

An examination of the preceding records of this experiment cannot fail to show that our original plan has been seriously interfered with by an early and persistent appearance of either scab or blight, or of both combined. The scab appeared in some parts of the field sooner than in others, — in the fertilized part of the soil sooner or more extensively than in the unfertilized soil. The results in 1884 were not as bad as in 1885. The seed potatoes used in 1885 were selected from our own crop; they were planted upon the same part of the field where they had been produced the preceding season. The system of manuring and of general treatment was the same as in the previous year. A blight on the leaves appeared that year in August, and terminated the experiment prematurely. The crop, when harvested August 26, was found suffering from scab in all parts of the field engaged in the experiment.

It was decided, in sight of these facts, to continue the experiment in 1886 upon the same field, with some modifications, to ascertain, if possible, whether the main influence regarding the results in our past observation had to be

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ascribed to atmospheric agencies, or to the condition of the soil and the fertilizer applied, or to the quality of the seed potato used.

1886.—The same field was used as in 1885. The land was well prepared by ploughing and harrowing April 27, and subsequently fertilized the same as in previous years. The change regarding the character of the fertilizer applied consisted in using nearly twice the amount of potash salts, muriate and sulphate of potash, for the same area, in case of plats 1 and 3. A second important change from our previous practice consisted in securing first quality seed potatoes, in particular free from scab. The same variety, Beauty of Hebron, was obtained for that purpose from Vermont; it was as fair an article as could be desired. The system of planting and cultivating was the same as in previous years. The potatoes were planted upon all plats May 5, 1886. All the vines were in full blossom July 6; they began to turn yellowish and dry up July 30. The crop on the entire field was dried up August 8. This change seemed to appear most marked, and first, on the vines raised from whole potatoes. The crop was harvested August 28.

Neither a liberal use of our own mixture of commercial manurial substances, rich in potash compounds, nor the selection of a fair quality of seed potatoes from another locality, had affected our results, as compared with those of the previous season; for the entire crop, with scarcely any exception, was badly disfigured by scab. The potatoes were unfit for family use, and had to be sold at a low price for stock feeding.

A due consideration of all the circumstances which accompanied our course of observations thus far, induced us to draw the following conclusions:—

1. Medium-sized whole potatoes give better results, as far as a large-sized, marketable crop is concerned, than half potatoes obtained from tubers of a corresponding size.

2. Disregarding the results of the first year, when previously existing resources of plant food in liberal quantities

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must have rendered the influences of an additional supply of manurial substances less marked, it appears that sulphate of potash produced better results in our case than muriate of potash.

3. The premature dying out of the vines, accompanied by blight or scab, or both, must be considered a controlling cause of an exceptionally large amount of small potatoes.

4. Some peculiar condition of the soil upon the lands used for this experiment is to be considered the real seat of our trouble. (For further details, see annual report.)

To test the correctness of conclusion 4 still further, the experiment was continued for another year.

1887.—The same plats as in previous years were utilized for the experiment. The subdivisions remained unchanged. The fertilizers applied were the same as in 1886.

The lands were ploughed and harrowed during the first week of May, and the potatoes planted in all plats May 11. First quality potatoes, Beauty of Hebron, raised in Vermont, were used as seed. The growth looked well upon all plats until July 28, when the vines on plats 2 and 3 began to turn yellow. They commenced drying up August 9, and by August 12 were dry on all plats. An examination of the little potatoes, July 1, showed already, in every case, the marks of scab.

The entire crop, when harvested, was so seriously affected by scab that it proved worthless in the general market.

The months of July and August were exceptionally wet and warm in our part of the State, a circumstance which has, most likely, aggravated our trouble.

The potato crop was in that year quite extensively a failure in our vicinity, wherever low lands had been used for its production.

1888.—The continued failure to raise upon this field a potato crop free from a serious attack of scab had strengthened our belief that neither the kind of fertilizer applied, nor

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the particular character of the season, nor the quality of the seed potatoes used, had any special relation to our results; but that some peculiar feature of the soil would ultimately prove to be the cause of our trouble.

Assuming that the presence of some injurious parasite in our soil might be the first cause of the scab, it was decided to devise some means by which its development would be prevented. The following course was adopted: Three plats, each forty-four by seventy feet, corresponding in location with plats 1, 2 and 3 in our description of preceding years, were assigned for the observation.

Plat 1, located on the eastern side of the stated area, received the same manure and in the same proportion as in the preceding year (600 pounds of fine-ground bones and 580 pounds of potash-magnesia sulphate per acre). The plat thus fertilized was subsequently subdivided into two equal parts, of which one received broadcast a mixture of one-half a pound of bi-sulphide of carbon and of ninety-five pounds of air-slaked lime; while the other half received broadcast a mixture of one-half a pound of carbolic acid and of ninety-five pounds of air-slaked lime.

In both instances the soil was subsequently slightly harrowed before the potatoes were planted.

Plat 2, located between plats 1 and 3, received, as in previous years, no fertilizer; but one hundred and ninety pounds of air-slaked lime were sown broadcast and harrowed in before planting. The application of lime was made here to assist in discriminating between the influence of a mere application of air-slaked lime, and that of a mixture of either bisulphide of carbon or carbolic acid and air-slaked lime.

Plat 3, forming the western end of our experimental field, received for manuring purposes, as in the preceding years, fine-ground bones and muriate of potash, at the rate of 600 pounds of the former to 300 pounds of the latter per acre. The fertilizer was applied broadcast and slightly harrowed in. The plat thus prepared, in a similar way to plat 1, was

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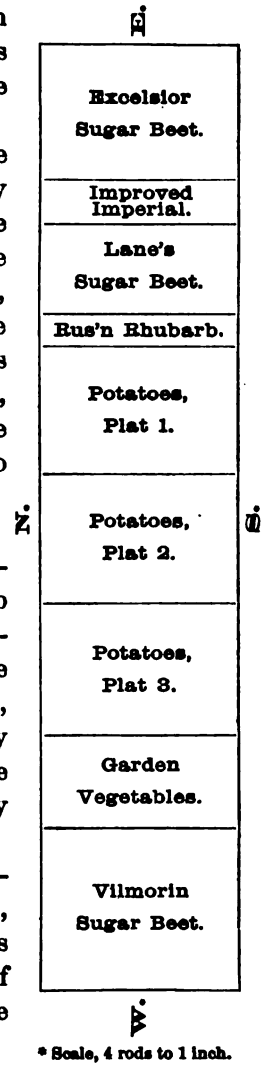
subsequently subdivided, like the latter, into two equal parts. One part was treated broadcast with a mixture of air-slaked lime and of bisulphide of carbon, and the other one with that of air-slaked lime and of carbolic acid, in the same way, as far as relative portions and total amount are concerned, before planting.

FIELD "D."*



* Scale, 4 rods to 1 inch.

The potatoes were planted on all the plats May 7; they appeared pretty uniform above ground May 27. The general treatment of the crop during the entire time was the same on all plats, and closely corresponded to the course pursued in preceding years. The vines began to change their color August 17, and were all dead August 31. The change seemed to be a natural one; no indications of blight could be discovered on the leaves; the extreme wetness of the season seemed to favor the continuation of the growing period. The crop on all the plats was harvested September 7. An examination of the entire crop, when spread out over the field, showed no marked difference in any particular part of the various plats. The potatoes were of a fair size, but seriously suffering from scab and rot.

Plat 1 yielded 1,080 pounds of potatoes; plat 2, 876 pounds, and plat 3, 976 pounds, of all sizes. Fifteen bushels of scabby potatoes, nearly one-third of the entire crop, were collected before the crop was removed from the field.

Although the results of the year are discouraging, the experiment will be repeated, with some modification, when a more favorable season may assist in the work.

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B. Observations with Scabby Potatoes.

The experiments were inaugurated in 1886 for the purpose of inquiring into the circumstances which control the development and the propagation of the scab on potatoes.

1886. — The first year's work in this connection has been confined to the task of observing the behavior of scabby potatoes as seed potatoes, under some definite previous treatment. To prevent a possible propagation of scab in the new crop by infected seed potatoes, the following course was adopted: Thoroughly scabby potatoes, obtained from the previously described experimental plats, were treated with some substances known to be destructive to various forms of parasitic growth. This operation was carried out with the intention of destroying the propagating power of adherent germs of an objectionable character before planting the seed.

The field for the experiment was distinctly separate from other experimental plats for the cultivation of potatoes. It had been used for many years previous for the raising of grass, and had since been planted but once, — the preceding year (1885), — with corn. The land was prepared by ploughing and harrowing in the same way as other potato fields. It was fertilized broadcast, at the rate of 600 pounds of ground rendered bones and 290 pounds of potash-magnesia sulphate.

The field was subdivided into five plats of equal size, eighty feet long and fifty feet wide, and the potatoes subsequently planted in rows, three feet three inches apart, with hills three feet from each other in the rows. Three feet of space was left between the plats unoccupied. The scabby seed potatoes selected for the trial were, as far as practicable, of a uniformly medium size. Each lot was immersed in the particular solution prepared for the different plats; after being kept there for twenty-four hours they were removed and directly planted.

Plat 1 was planted with healthy and smooth potatoes, without any previous treatment. This course was adopted to learn whether soil, fertilizer, or atmospheric agencies of the season would favor the appearance of scab in the crop.

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Plat 2. The scabby seed potatoes were allowed to remain for twenty-four hours in a saturated solution of muriate of potash before being planted.

Plat 3. A strong solution of hypochlorite of lime (bleaching lime) was applied in a similar way, for the preparation of the scabby seed, as in case of plat 2.

Plat 4. A saturated solution of carbolic acid in water served in this instance for the treatment of the scabby potatoes.

The potatoes were planted in all plats on the same day, May 7. The vines did not appear evenly at first; they were, however, equally vigorous upon all plats at the close of June.

The tops on all plats were pretty generally dried up August 8. The potatoes were harvested on the entire field August 30. The yield on all plats was fair, and the quality of the potatoes, almost without exception, excellent; this seemed to be more striking in regard to those on plats 2, 3 and 4, which had been, in the beginning of the season, somewhat behind in growth. Here and there could be seen a potato with a small mark of scab; a large proportion were perfectly smooth, and without any sign of it. The results were recorded as those of a first experiment.

The fact that a scabby potato may produce, under certain circumstances, a smooth and otherwise excellent potato, was confirmed. Good potatoes have been raised before from seed potatoes suffering from scab, without any previous treatment similar to ours. Without any intention of anticipating the results of future observations, or to point out with certainty the exact cause of our results, we expressed the opinion that a difference in the condition of the soil in our old and new experimental potato plats might have proved to be the principal cause of our trouble; for the former yielded, from healthy potatoes, most inferior scabby potatoes; while the latter produced, from scabby potatoes, a most superior, smooth potato, under otherwise almost identical conditions, as far as soil, mode of cultivation and kind of fertilizer were concerned, upon lands in close proximity, during the same season.

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1887. — The experiment was repeated upon the same lands, with but a slight modification. The soil was ploughed and fertilized, as in the preceding year. Ten plats, each fifty feet long, were planted with four rows of potatoes, three feet three inches apart, and with nineteen hills in the row. Medium-sized, whole scabby potatoes (Beauty of Hebron), selected from the crop raised upon our own fields during the previous year, and which is described in some preceding pages under the heading "Potato Experiment, A," served as seed potatoes. One-half the plats were planted with scabby potatoes, all from the same lot, after being immersed for eighteen hours in some solution prepared for that purpose; and the other half were planted without any previous treatment of the seed, — plats 2, 6 and 10 with our scabby potatoes, Beauty of Hebron, and plats 4 and 8 with healthy, smooth tubers, of the same variety.

Plat 1. Scabby potatoes, soaked in a solution of potassium sulphide.
Plat 2. Scabby potatoes, without any particular treatment.
Plat 3. Scabby potatoes, treated with a solution of hypochlorite of lime (bleaching lime).
Plat 4. Smooth, healthy potatoes, without previous treatment.
Plat 5. Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
Plat 6. Scabby potatoes, without previous treatment.
Plat 7. Scabby potatoes, treated with a solution of carbolic acid.
Plat 8. Smooth, healthy potatoes, not treated.
Plat 9. Scabby potatoes, treated with copper sulphate (blue copperas).
Plat 10. Scabby potatoes, not treated.

The young plants made their appearance on all plats, except plat 9, June 1; those on plat 9 appeared eight or ten days later. The entire crop looked uniformly well. The vines dried up on all plats at about the same time. The crop was harvested with the following results: —

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BEAUTY OF HEBRON.

PLAT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results (Sept. 12, 1887).
No. 1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
" 2,		Scabby.	None.	Good; not scabby.
" 3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
" 4,		Good.	None.	Somewhat scabby.
" 5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
" 6,		Scabby.	None.	Good; not scabby.
" 7,		Scabby.	Carbolic acid.	Especially good.
" 8,		Good.	None.	Especially good.
" 9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
" 10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results tends to show that a certain condition of the soil has been the leading cause for the origin and propagation of the scab; for scabby seed potatoes have produced healthy, smooth tubers, both with and without any special previous treatment (see plats 1, 2, 7 and 8). On the other hand, it is not without interest to notice that plats 1, 3 and 7 have furnished us with some of the best potatoes we have raised during the past season.

1888.— The field occupied by the experiment was the same as during the preceding year. The same arrangement of plats was adopted. The preparation of the soil, as far as ploughing and manuring are concerned, was the same as in the preceding season. The solutions of chemicals for the treatment of part of the seed potatoes was identical with that of the preceding year. All the details of the field work, beginning with planting and ending with harvesting, were closely corresponding to the course pursued in 1887.

The potatoes were planted May 9; the vines died on all plats, apparently without any exceptional external cause, between August 23 and 31. No marked difference could be noticed in the appearance of the potatoes from the various plats. All plats had produced some scabby potatoes. The

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result of the season is, to say the least, an indifferent one, as far as the action of the various solutions of antiseptics as a preventive of scabby potatoes is concerned.

The conclusion arrived at in previous years has evidently received an additional support by the results of the past season. Every one of our observations thus far made in this connection points towards the soil as the bearer of the cause of the scab on potatoes. The inquiry into the first cause of the scab will be continued.

Those of our readers who are not familiar with the present views entertained by scientists regarding the real character of the scab on potatoes, will find Professor Humphrey's discussion of this subject, which accompanies this chapter of our annual report, very interesting and profitable reading.

It has been considered of interest to photograph the seed potatoes, and subsequently some specimens of a corresponding size of those raised from them. This course it is thought will furnish us in time with an exact record of the exterior characteristics of genuine varieties, and assist us in discriminating between new and old. As the Beauty of Hebron, Early Rose and Polaris (originated by H. F. Smith of Waterbury Centre, Vt.) have been the principal varieties raised upon the fields of the Station during the past season, their photographs accompany this report. A picture of the Colorado wild potato, raised on our lands, may not be without interest in this connection. The pictures are in every case taken at an equal distance, and thus allow a comparison of relative sizes.

DESCRIPTION OF PHOTOGRAPHS OF POTATOES.

		Largest. Weight in ounces.	Medium. Weight in ounces.	Smallest. Weight in ounces.
Picture No. 1.	Beauty of Hebron Potatoes,	7 to 19	3 to 6½	2½ to 3½
Picture No. 2.	Early Rose Potatoes, . .	4 to 8	2½ to 3½	1½ to 2½
Picture No. 3.	Polaris Potatoes, . .	6 to 11	3 to 5½	2 to 3
Picture No. 4.	Colorado Wild Potatoes, .	–	–	–

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No. 1.

BEAUTY OF HEBRON (SEED POTATOES FOR 1888).

BEAUTY OF HEBRON (POTATOES RAISED IN 1888).

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No. 2.

Early Rose (Seed Potatoes for 1888).

Wright & Potter Printing Co., State Printers.

Early Rose (Potatoes Raised in 1888).

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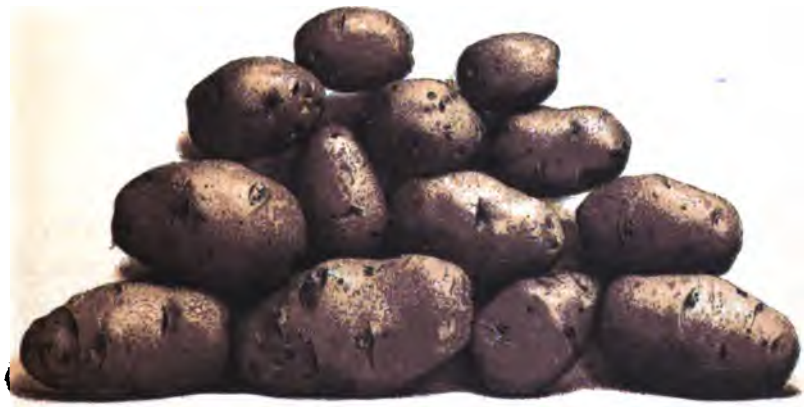
No. 3.

Polaris (Seed Potatoes for 1889).



Polaris (Potatoes Raised in 1888).

No. 4.

Colorado Wild Potatoes (Raised in 1888).

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POTATO SCAB.

BY JAS. ELLIS HUMPHREY, PROFESSOR OF VEGETABLE PHYSIOLOGY.

The value of the potato crop in Massachusetts exceeds that of any other planted crop; consequently, the loss by any widespread and serious disease of this crop must be an important item. The commonest and most constant disease which attacks the potato in the field is that commonly known as the "scab." It is well known in both Europe and America, and attacks the tubers, giving little or no evidence of its presence in those parts of the plant above ground. The cause of this trouble is not at all understood, though various theories are held as to its nature. It is proposed in the present paper to discuss briefly the present state of our knowledge of the potato scab, by way of introduction to a series of investigations of the disease which the writer expects to carry on during the coming year.

The disease first manifests itself in the form of small corroded spots or pustules on the surface of the potato. Writers on the subject generally agree that these spots replace the "lenticels" of the tubers.

If a smooth potato tuber be closely examined, there will be seen spots of the size of a pin's head or smaller, of a slightly different shade, and somewhat roughened or granular in appearance. These breaks in the continuity of the tissue of tabular cork-cells which form the so-called "skin" of the potato, are filled with loose, globular cork-cells, through whose intercellular spaces an interchange of gases can take place between the interior of the potato and the outer air. They are then, so to speak, the *ventilators* of the tuber, and are known as "lenticels." (The normal structure of the potato tuber is shown in the accompanying Fig. 2.) It is in these lenticels that the scab originates or first shows itself.

From these spots the disease rapidly spreads, until sometimes almost the whole exterior of the tuber becomes involved in the decay and breaking down of the surface tissue. In many cases, at least, there are developed over these patches, rough, brittle scales or crusts of corky tissue, which peel readily from the surface, and which render the name

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"scab" an appropriate one for the disease. In Fig. 1 is shown the appearance of the fully developed scab, reproduced from photographs of potatoes raised on the plats of the Station in 1888. This whole change goes on while the tuber is still in the ground; and after the crop is dug and stored, no further change occurs. The disease affects the tissue to a depth of only a few cells, all below remaining in a normal, healthy condition. The cells affected lose their starch, and contain, in its place, according to some writers, globular brown masses, usually regarded as disorganized cell-contents. In so far as the starch, which gives its chief food value to the potato, is destroyed, that value is lessened; but the unsightly appearance of "scabby" tubers causes a much greater proportional decrease in their selling value, since, by paring away the affected superficial tissue, the remainder is made perfectly suitable for food.

The cause of this disease has been discussed by several writers. Most of the views expressed are based on the first important discussion of the subject by Schacht, in a work on the potato plant and its diseases.* This author believes that the efficient cause of the scab is an excess of moisture in the soil. It can readily be shown, that, when a potato tuber is exposed to an abundance of moisture, the lenticels become more prominent, in consequence of the loosening and separation of the cells which fill them. This affords, Schacht thinks, an easy opportunity for the water to enter those tissues of the tuber bordering the lenticels. They thus become water-soaked, and rapidly decay, assuming a dark and muddy appearance. Two of the chief recent writers on the diseases of plants, Frank and Sorauer, adopt this view. Frank † regards the disease as a case of breaking down of tissue, originating in what is practically a wound. Sorauer ‡ thinks the scab develops rapidly during short but specially favorable periods, and instances, as such a period, the time of a heavy rain following a drought. Each of the above writers mentions as a possible cause, or at least an aggravating condition, the presence of lime, marls, or especially

* Bericht über die Kartoffelpflanze und deren Krankheiten, Berlin, 1854, p. 24.
† Krankheiten der Pflanzen, Berlin, 1880, p. 140.
‡ Handbuch der Pflanzenkrankheiten, Berlin, 1886, vol. i, p. 227.

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of iron oxide in the soil; and Sorauer thinks that ammonia set free from the soil may sometimes have a similar influence. Another authority, W. G. Smith,* considers that the chief cause is mechanical irritation, from the presence in the soil of corrosive substances; and states that a difference may often be noticed in the degree of scabbiness of potatoes from different parts of the same field, depending on the relative proportions of refuse in the soil of the different parts. Smith also says that one form of the disease may be caused either by long drought or by excess of moisture. All authors agree that the scab-like crusts, which characterize the disease in its complete development, originate from the natural effort of the plant to repair the injury to the tuber by a secondary formation of cork. Sorauer differs from the others quoted, in rejecting the theory of irritation or corrosion as a primary cause of the trouble. He quotes at length several experiments, conducted in German experiment stations and elsewhere, whose results seem to be conclusive against the idea that foreign substances in the soil can cause the disease by mechanical or chemical action.

We may now proceed to consider the bearing of some recent American observations on the views already stated. The only experiments undertaken in this country for the purpose of testing current theories, with which I am acquainted, are those of Arthur and Beckwith of the New York Experiment Station.† Plats of potatoes were planted and kept under identical conditions, except that half of the hills were kept wet by irrigation, while the others were not artificially watered. One-half of the hills of each class were planted without manure, and the remainder were manured. In the unmanured hills, abundant moisture had practically no influence, for the percentage of scabby potatoes was very nearly the same in the irrigated and unirrigated portions. On the other hand, the irrigated hills on the manured ground produced seventy-one per cent. of scabby tubers, against only thirty per cent. from the unwatered hills. A general average gives forty-eight per cent. of scabby tubers on the irrigated

* Diseases of Field and Garden Crops, London, 1884, p. 37.

† Sixth Annual Report of the New York Agricultural Experiment Station, 1888, pp. 307 and 344.

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ground, to thirty-one per cent. on that unirrigated; and fifty-one per cent. of diseased ones on the manured ground, against twenty-two per cent. where manure was not used. These results indicate that an abundance of moisture favors the development of scab, but can hardly be held to support the view that it is the chief *cause* of the disease. Beckwith concludes from his experiments that an increased yield is nearly always accompanied by an increase of scab; and that any marked change in the rapidity of the growth of the tubers favors its development, a continuous growth from their first formation to maturity being least favorable to the appearance of the disease. The last point may, perhaps, be regarded as another aspect of Sorauer's view that a heavy rain after drought especially aids the development of scab.

Observations made at this Station during the past five years, and detailed in its reports,* also bear interestingly on the subject. The experiments were begun with a wholly different end in view, but were vitiated the first year by the appearance of scab, which has persistently appeared on the same plats in every succeeding year. The first year, when the land was freshly broken, the trouble was less severe, and a difference in severity was noticed on plats differently fertilized. Since the first year, the crop has been uniformly scabby, but not more so in wet than in drier seasons. The experiments thus far, while by no means conclusive in their results, seem to point to peculiar soil conditions as the most probable cause of the disease.

In 1887 there appeared a paper by a Norwegian naturalist, Brunchorst,† on a disease of potatoes common in that country, and there called "Skurv," which he believes to be, and which, from his description, seems to be, the same as the German "Schorf" and the English and American "scab." This writer states that the masses noticed by other investigators in the dead cells of the tuber, and by them supposed to be composed of disorganized cell-contents, are really the resting condition of a parasitic organism, whose attacks

* Second to Sixth Annual Reports of Massachusetts Agricultural Experiment Station, 1885–89.

† Ueber eine sehr verbreitete Krankheit der Kartoffelknollen. In Bergens Museums Aarsberetning for 1886, p. 219.

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cause the disease. He describes in detail the structure of these masses, as he understands them, but has not seen the supposed parasite in its active state. He names the organism *Spongospora Solani*, and regards it as closely related to *Plasmodiophora Brassicae*, discovered by Woronin * in 1877, and now generally regarded as the cause of the so-called "club foot" or "stump root" disease of cabbages and turnips. For a better understanding of Brunchorst's theory, it may be well to give here a very brief account of the "club foot" parasite.

On emerging from its resting state under the influence of favorable conditions for vegetation, it appears as an almost inconceivably tiny, naked mass of protoplasm, with the power of moving or creeping about in moist soil. Here it may attack a young root of either of several plants of the Mustard family, most commonly of a cabbage or turnip. Penetrating a surface cell, it lives and grows at the expense of the contents of that cell, moving on to another when the first is exhausted. Cells thus attacked increase in size, in consequence of the abnormal stimulus caused by the presence of the parasite, which often also causes a large increase in the number of cells in the affected region. This hypertrophy produces the characteristic swellings which give the disease its name. As a result of the growth and fusion of the protoplasmic masses of the organism, many of the root-cells become at length filled by them. Each of these masses separates, toward the close of the season, into numerous very small globular ones, and each of the latter secretes a wall or coat about itself. In this condition the organism can survive considerable extremes of cold or dryness, and can await the recurrence of favorable conditions. When the weather again permits, the walls or coats crack open, and the contained bits of protoplasm emerge from their rest, each one taking up its active life, and repeating the cycle just outlined. Brunchorst believes the history of his *Spongospora* to be very similar to the above, differing chiefly in the fact that the numerous masses, into which the parasitic contents of one cell divide, remain angular and closely compacted into a spongy structure, instead of becoming

* Pringsheim's Jahrbücher für wissenschaftliche Botanik, vol. xi, p. 548.

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globular and separate, as in *Plasmodiophora*. In Fig. 3 are shown the active and resting stages of the latter, and Brunchorst's representation of the resting state of his supposed scab parasite.

Both the New York and the Massachusetts observations, before referred to, bear on Brunchorst's views. If the scab is caused by a living organism, its development must be checked by the application of substances fatal to parasitic forms of life; and scabby potatoes would be expected to produce usually a scabby crop, when planted, the infected tubers infecting the new generation. Experiments with fungicides, at both stations named, gave only negative results, the decrease in scabbiness where they were used being insignificant. The average proportion of scabby tubers produced from scabby "seed" in the New York experiments was forty-five per cent., while smooth "seed" yielded thirty-seven per cent. of diseased potatoes. At our own Station the crops have varied little in quality, when raised under similar conditions, whether from smooth or scabby "seed;" and badly diseased tubers have, in several cases, produced exceptionally good crops.

One further observation, noted by Beckwith in the report quoted, is of interest. He finds that, while forty-three per cent. of the white-skinned potatoes and fifty-three per cent. of the flesh-colored ones raised on the station farm were scabby, only twenty-seven per cent. of the dark-skinned ones were affected. Assuming the cause of the disease to be external to the tuber, such a result was to be expected.

From the above statement, it is evident that much remains to be learned before our knowledge of the cause of the potato scab will be at all satisfactory. And, until a pretty definite knowledge of its cause is gained, all attempts at discovering a remedy are so many leaps in the dark. The conditions at this Station are in many respects very favorable for a hopeful prosecution of investigations into the nature and origin of the pest, which are planned for the coming season. The writer will be very glad of suggestions or reports of experience from persons who have had to do practically with the disease, or to communicate with any who are interested in this subject of inquiry.

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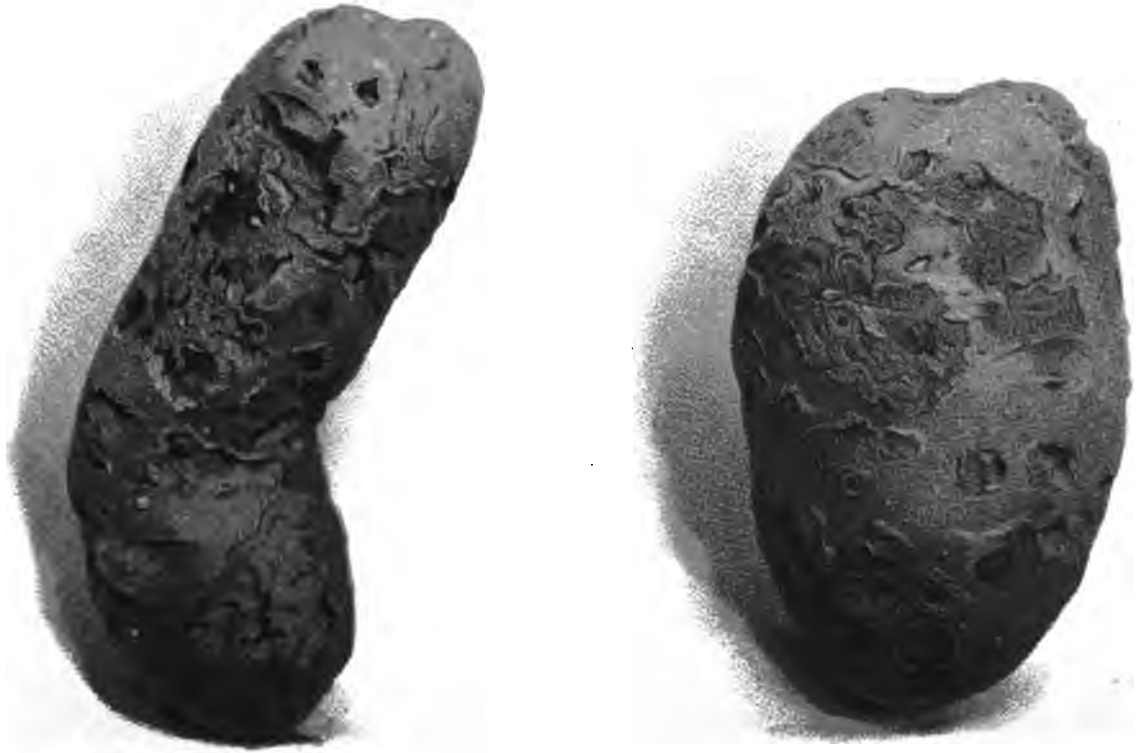

FIG. 1.

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Fig. 1. Two potatoes, "Beauty of Hebron," from Station plats, badly affected by "scab," illustrating the usual form of the disease. *From photographs.* Five-sixths natural size.

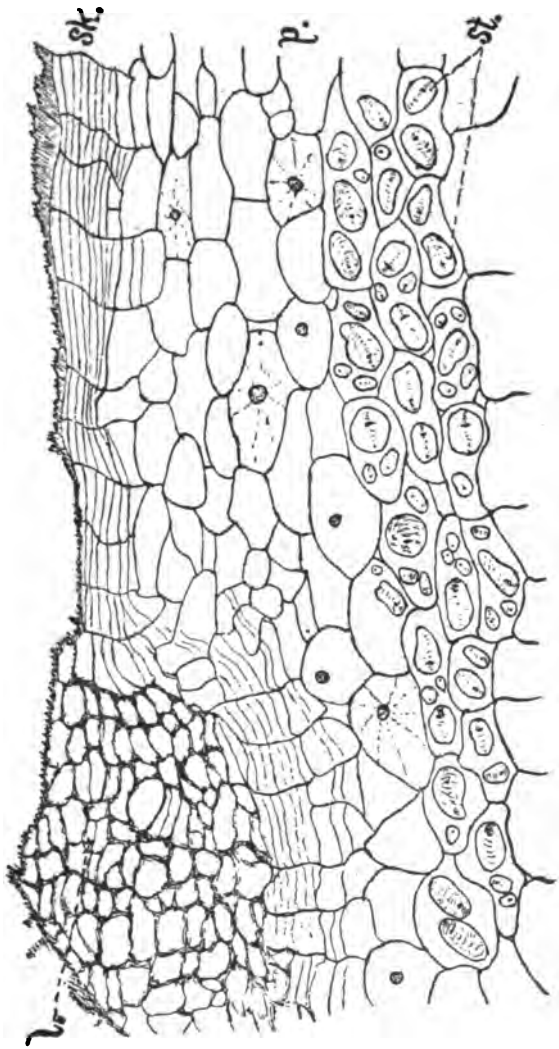

Fig. 2.

Fig. 2. Section taken at right angles to the surface of a healthy potato tuber, showing its normal structure.

sk. The "skin" of the tuber, of tabular cork-cells.

l. A lenticel, filled with rounded cork-cells.

p. The parenchymatous tissue, which forms the bulk of the tubers, containing starch-grains, *st.*

Original. Magnified one hundred diameters.

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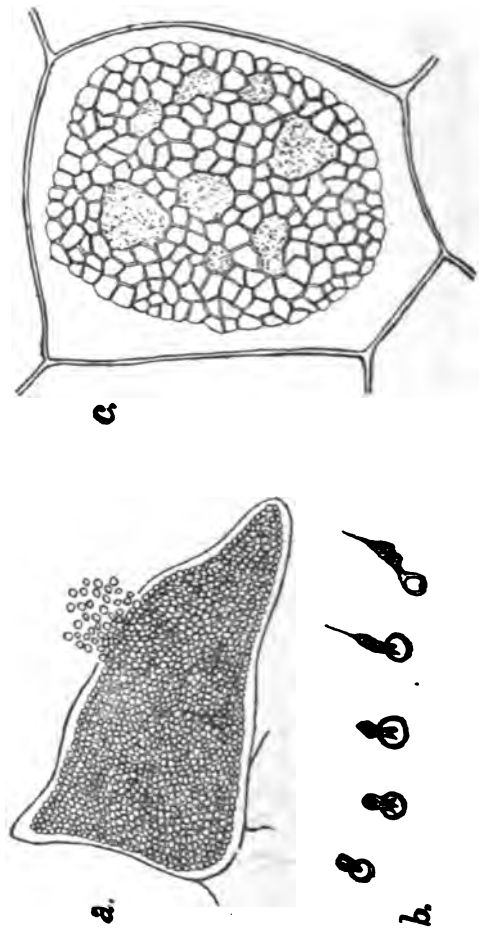

Fig. 3.

Fig. 3. *a.* Cell from diseased root of cabbage, showing resting stage of *Plasmodiophora Brassicae*, *Woronin*, the "club-foot" parasite.

b. Protoplasmic masses of *P. brassicae* emerging from the resting state.

c. Cell from scabby potato, showing resting stage of *Spongospora Solani*, *Brunchorst*, the supposed "scab" parasite.

a and b, after Woronin. *a* magnified one hundred diameters, *b* magnified six hundred diameters.

c, after Brunchorst. Magnified one thousand diameters.

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V. Experiments with Root Crops.

The importance quite generally conceded to the introduction of a liberal cultivation of root crops in a mixed farm management, wherever a deep soil and the general character of the climate favors their normal development, rests mainly on the following consideration: They furnish an exceptionally large amount of valuable vegetable matter, fit for fodder for various kinds of farm live stock, competing in this direction favorably with our best green fodder crops; and they pay well, on account of large returns, for the necessary care bestowed upon them by a thorough, deep cultivation to meet success.

The physical condition of the soil, however favorable it may have been for the production of crops of a similar character, will suffer if year after year the same system of cultivation is carried out. Diversity in the mechanical treatment of the soil, and change of season for such treatment, cannot otherwise but affect advantageously its mechanical condition and the degree of its chemical disintegration, promoting thereby its fitness for developing inherent plant food, as well as its power of turning to account atmospheric resources of plant growth. The roots of the same plants abstract their food year after year from the same layer of soil, while a change of crops with reference to a different root system renders it possible to make all parts of the agricultural soil contribute in a desirable succession towards an economical production of the crops to be raised. Deep-rooting plants, like our prominent root crops, for this reason deserve a particular consideration in the planning of a rational system of rotation of crops.

To raise roots the second year, after a liberal application of coarse barn-yard manure, or the turning over of grass lands with the assistance of some commercial phosphatic fertilizer in the interests of a timely maturity, is highly recommended by practical cultivators of sugar beets. To stimulate in the roots the production of the largest possible amount of sugar and starch must be the object of the cultivator, for these two constituents of roots control, more than any other one, their increase in solids.

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Root crops, although somewhat peculiar in their composition when compared with many of our prominent fodder articles, have proved a very valuable constituent in the diet of various kinds of farm live stock, when properly supplemented by hay, grain, oil cake, bran, etc., as circumstances may advise. Our experience at the Experiment Station confirms fully the valuable services of roots as an ingredient of fodder rations for milch cows. (For details on this point, see "Feeding Experiments with Milch Cows," in our fourth and fifth annual reports.)

The encouragement received on that occasion has served as an inducement to continue our work in this direction. The aim has been to experiment with the best varieties of roots at our disposal. The preceding annual report contains a short sketch of the field work carried out during the year 1887. The different varieties of roots raised had been photographed, and copies taken by the heliotype process accompanied the report. The discussion of their composition and of their comparative agricultural value had to be left for a later date, on account of the closing up of the annual report before that work was finished. The same course we are obliged to pursue, for the same reason, in regard to our field experiments with root crops during the late season (1888). Our present communication comprises, first, the analyses of roots raised in 1887; and second, a description of the work carried on in the field with different varieties of valuable roots for feeding purposes.

1. *Analyses of Roots raised upon the Lands of the Station in 1887.*

The seeds used in our experiments were sent on by the United States Department of Agriculture, with the exception of No. 7, — Saxony sugar beet, — which was taken from our collection of imported seeds. The field work was planned with a view to ascertain the general character and the particular composition of the different varieties of roots on trial, when raised, as far as practicable, under corresponding circumstances with reference to the peculiarity of season, the quality of soil, the system of manuring and the mode of cultivation.

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The land consisted of a good loam in a fair condition of fertilization. It has been manured for several years past, annually, with a mixture consisting of six hundred pounds of fine-ground bone and two hundred pounds of muriate of potash per acre. The seeds, ten varieties in all, were sown May 25. Each variety occupied two rows across the field, of equal length (eighty feet).

No. 1. Beet, Mangel Wurzel, "Giant Long Red."
2. Beet, Mangel Wurzel, "Yellow Ovoid."
3. Beet, "Eclipse."
4. Beet, "Red Globe."
5. Beet, "Egyptian Turnip."
6. Beet, "Long Smooth Red."
7. Beet, "Saxony" Sugar Beet.
8. Turnip, Ruta-baga, "White Sweet German."
9. Turnip, "Early Yellow," or "Golden Stone."
10. Turnip, Ruta-baga, "Skirving's Purple Top."

The rows were three feet three inches apart. The young plants were in every case thinned out or transplanted, as circumstances advised, to about eight inches distant from each other in the rows.

The transplanting and thinning out took place between July 5 and 11; the weather during this time was favorable for transplanting. The seeds of Nos. 6 and 9 did not prove as good as the others; the young plants of Nos. 5 and 9, in particular, did not do as well after transplanting as the remainder.

The crop was harvested between October 31 and November 2. The roots, after being removed from the ground, were topped, and three of each kind were taken to the laboratory for a chemical examination, while three of an approximately corresponding size were photographed.

The three sample roots selected in each case represented, as far as practicable, the smallest, medium and largest of each variety raised.

The specimens selected for our fodder analyses were kept in the cellar, slightly covered with moist earth, until wanted for the chemical examination.

The photographs were taken in every case with the roots at an equal distance from the camera. (See illustrations, pages 148–150, in our last annual report.)

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Statement of Field Results.

NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples photographed.
			lbs.	lbs.
1. Mangel Wurzel, "Giant Long Red,"	2	150	305	11.75
2. Mangel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
3. Beet, "Eclipse,"	2	163	235	4.
4. Beet, "Red Globe,"	2	173	335	7.5
5. Beet, "Egyptian Turnip,"	2	146	170	3.75
6. Beet, "Long Smooth Red,"	2	145	186	5.
7. Sugar Beet, "Saxony,"	2	144	314	3.75
8. Ruta-baga, "White Sweet German,"	2	176	445	4.
9. Turnip, "Early Yellow," or "Golden Stone," . .	2	43	50	5.5
10. Ruta-baga, "Skirving's Purple Top,"	2	140	296	12.75

Beets.

[I. Mangel Wurzel, "Giant Long Red," weight, 2 lbs. II. Mangel Wurzel, "Yellow Ovoid," weight, 2 lbs. 3 oz. III. "Eclipse," weight, 1 lb. 4 oz.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C., ...	86.92	87.66	Not determined.*
Dry matter, ...	13.08	12.34	
	100.00	100 00	
Analysis of Dry Matter.			
Crude ash, ...	8.35	11.01	8.86
" cellulose, ...	9.54	7.21	4.29
" fat, ...	.90	1.01	.85
" protein (nitrogenous matter),	7.83	10.45	10.09
Non-nitrogenous extract matter, .	73.38	70.32	75.91
	100 00	100.00	100.00

* The sample had suffered a loss in original moisture from exposure.

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Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.92	87.66	–
Nitrogen,	.171	.206	.282
Phosphoric acid,	.102	.085	.156
Potassium oxide,	.305	.462	.587
Calcium oxide,	.064	.059	.062
Magnesium oxide,	.047	.031	.045
Sodium oxide,	.145	.105	.055
Ferric oxide,	.006	.004	.005
Insoluble matter,	.028	.018	.043
Valuation per 2,000 lbs.,	$0 94	$1 17	$1 62

BEETS.

[IV. "Red Globe," weight, 1 lb. 2 oz. V. "Egyptian Turnip," weight, 1 lb. 2 oz. VI. "Long Smooth Red," weight, 1 lb. 10 oz.]

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Dry matter,	13.05	14.20	14.51
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.57	5.80	8.99
" cellulose,	4.52	6.23	5.47
" fat,	1.76	.82	.79
" protein (nitrogenous matter),	12.17	7.82	11.80
Non-nitrogenous extract matter,	70.98	79.33	72.95
	100.00	100.00	100.00

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Fertilizing Ingredients in the Above Beets.

	Per Cent.		
	IV.	V.	VI.
Moisture at 100° C.,	86.95	85.80	85.49
Nitrogen,	.264	.177	.236
Phosphoric acid,	.079	.070	.087
Potassium oxide,	.525	.303	.377
Calcium oxide,	.044	.049	.040
Magnesium oxide,	.025	.035	.044
Sodium oxide,	.110	.061	.099
Ferric oxide,	.004	.002	.003
Insoluble matter,	.013	.018	.028
Valuation per 2,000 lbs.,	$1 42	$0 92	$1 20

Sugar Beet.

[VII. "Saxony," weight, 1 lb. 11 oz.]

	Per cent.
Moisture at 100° C.,	83.32
Dry matter,	16.68
	100.00

Analysis of Dry Matter.

Crude ash,	5.09
" cellulose,	5.81
" fat,	.39
" protein (nitrogenous matter),	7.32
Non-nitrogenous extract matter,	81.39
	100.00

Fertilizing Ingredients in Sugar Beet.

Moisture at 100° C.,	83.32
Nitrogen,	.209
Phosphoric acid,	.136
Potassium oxide,	.383
Calcium oxide,	.052
Magnesium oxide,	.034
Sodium oxide,	.113
Ferric oxide,	.025
Insoluble matter,	.032
Valuation per 2,000 lbs.,	$1 18

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TURNIPS.

[VIII. Ruta-baga, "White Sweet German," weight, 2 lbs. 2 oz. IX. "Early Yellow" or "Golden Stone," weight, 14 oz. X. Ruta-baga, "Skirving's Purple Top," weight, 2 lbs. 11 oz.]

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Dry matter,	12.77	12.80	11.60
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.81	8.01	9.24
" cellulose,	11.04	10.96	11.60
" fat,	1.23	1.42	2.32
" protein (nitrogenous matter),	10.34	10.81	11.16
Non-nitrogenous extract matter,	68.58	68.80	65.68
	100.00	100.00	100.00

Fertilizing Ingredients in the Above Turnips.

	Per Cent.		
	VIII.	IX.	X.
Moisture at 100° C.,	87.23	87.20	88.40
Nitrogen,	.211	.221	.207
Phosphoric acid,	.136	.116	.125
Potassium oxide,	.546	.412	.452
Calcium oxide,	.106	.117	.080
Magnesium oxide,	.030	.033	.027
Sodium oxide,	.051	.133	.141
Ferric oxide,	.002	.009	.004
Insoluble matter,	.001	.072	.017
Valuation per 2,000 lbs.,	$1 32	$1 22	$1 21

The closing months of the summer season of 1887 were marked by an exceptional amount of rainfall. The serious influence of that circumstance showed itself in various direc-

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tions in our vicinity. Some crops in low localities suffered more or less a premature decay, others did not reach their full maturity in due time. Our root crop, judging from the results of our examination, evidently did not reach its full perfection on account of the exceptional wetness of the latter part of the growing season. The moderate amount of dry vegetable matter found in the well-studied variety of Saxony sugar beet, as well as the large proportion of the nitrogen most of them contained in other combinations than in that of true albuminoid substances, entitle to that conclusion. Root crops are commonly reported to contain on an average from thirty-five to forty-five per cent. of their nitrogen in other and less valued combinations than the typical albuminous matter or the genuine protein substances. An examination of the subsequent tabular statement of some tests in that direction shows that our roots, as far as they have been submitted to an actual observation (1–7), contained from fifty-two to seventy per cent. of their nitrogen in various combinations quite generally considered of less nutritive value than the group of typical albuminous substances. The last-named class of compounds reaches usually its highest attainable proportions in a plant or part of a plant at the state of maturity.

DETERMINATION OF ALBUMINOID NITROGEN IN ROOTS RAISED UPON THE FIELDS OF THE STATION.

	Per Cent.		
	Total Nitrogen.	Albuminoid Nitrogen.	Non-Albuminoid Nitrogen.
Root No. 1, ...	1.20	0.58	0.62
" 2, ...	1.61	0.55	1.06
" 3, ...	1.53	0.56	0.97
" 4, ...	1.90	0.57	1.33
" 5, ...	1.20	0.58	0.62
" 6, ...	1.81	0.51	1.30
" 7, ...	1.25	0.60	0.65

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The various kinds of roots usually raised on farms for feeding purposes differ essentially in regard to the amount of dry vegetable matter they contain. Turnips contain from seven to eight per cent.; ordinary mangolds from eleven to twelve per cent.; improved varieties of beet roots, like Lane's, from fifteen to sixteen per cent.; good carrots from fourteen to fifteen per cent.; a good sugar beet from eighteen to twenty per cent. of solids; or, in other words, one ton of an improved variety of good sugar beets is equal to from two to two and one-half tons of ordinary turnips, as far as the amount of dry vegetable matter is concerned.

Modes of cultivation and of manuring exert a decided influence in this direction on the composition of the roots. Large roots of the same variety contain quite frequently less solid matter than the smaller ones. Close cultivation in the rows, in connection with the use of well-decomposed manurial matter as fertilizer, tends to produce good results.

The difference in the amount of solids, as far as each kind of root is concerned, is otherwise due, in the majority of cases, to a more or less perfect maturity. A liberal manuring with potash and nitrogen, in connection with a scanty supply of phosphoric acid, is frequently the cause of immatured roots at the ordinary harvest time.

2. *Field Observations with Root Crops in 1888.*

The field used for the work was of the same character as in the preceding trial. It represents a part of field "D" on our records, and is 328 feet long and 70 feet wide. The main field runs from east to west, and the rows run in all cases from south to north. The soil consists of a deep, sandy loam, and has been fertilized for several years annually with the same fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. Some of the land has been used before for the raising of root crops. It was ploughed in the autumn, 1887, and again on April 26, 1888. The fertilizer was applied April 30, in the customary way, broadcast, and slightly harrowed in before planting. The rows were seventy feet long and three feet three inches apart. The seed was taken partly from our own imported stock of previous years, and

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partly chosen from varieties sent on by the United States Department of Agriculture at Washington, D. C. The following varieties were seeded May 17 and 19: —

		Rows.
No. 1.	Excelsior Sugar Beet,	15
2.	Improved Imperial Sugar Beet,	6
3.	Vilmorin Sugar Beet,	14
4.	Lane's Sugar Beet,	9
5.	New Market Gardener Beet (red),	1
6.	Eclipse Beet (red),	1
7.	Osborn's Selected Beet (red),	1
8.	Yellow Danver's Carrot,	90

One row was planted with Saxony sugar beet, from our crop of 1887, for the purpose of raising seeds for our own consumption during the coming season.

The young plants appeared in all cases above ground May 28; they were in every instance, whenever necessary, thinned out to have them eight inches apart in the rows; none were transplanted.

The average number of roots in a row was at the end of the season as follows: —

	Plants.
Excelsior Sugar Beet,	89
Improved Imperial Sugar Beet,	96
Vilmorin Sugar Beet,	119
Lane's Sugar Beet,	105
New Market Gardener Beet,	67
Eclipse Beet,	118
Osborn's Selected Beet,	122

The entire yield of each of these varieties of beet roots without tops amounted to, —

1,870 pounds in fifteen rows of Excelsior.
1,070 pounds in six rows of Improved Imperial.
3,355 pounds in fourteen rows of Vilmorin.
1,250 pounds in nine rows of Lane's.
125 pounds in one row of New Market Gardener.
150 pounds in one row of Eclipse.
130 pounds in one row of Osborn's Selected.

The Vilmorin sugar beet exceeds in our case in yield all other sugar beets, allowing an equal number of rows with an equal number of plants. The yield per acre, with rows three feet and three inches apart, at our rate of production would amount to 22.95 tons.

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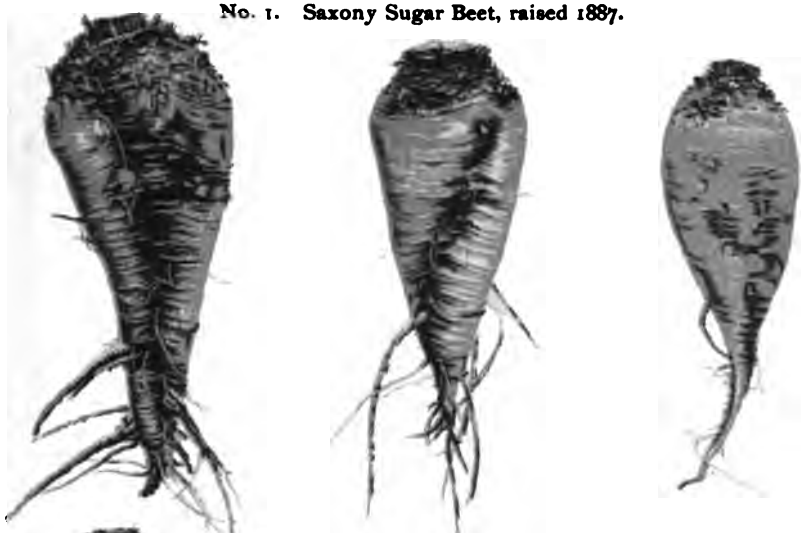
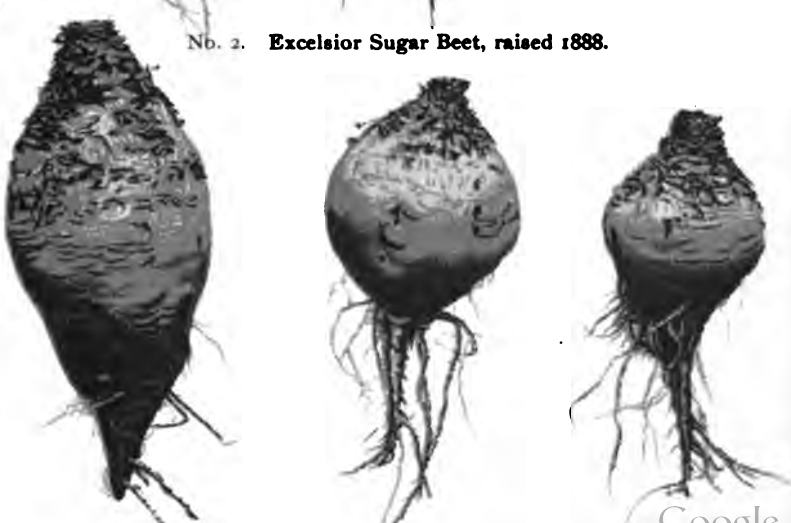
No. 1. Saxony Sugar Beet, raised 1887.



No. 2. Excelsior Sugar Beet, raised 1888.



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No. 3. Improved Imperial Sugar Beet, raised 1888.

Wright & Potter Printing Co., State Printers.

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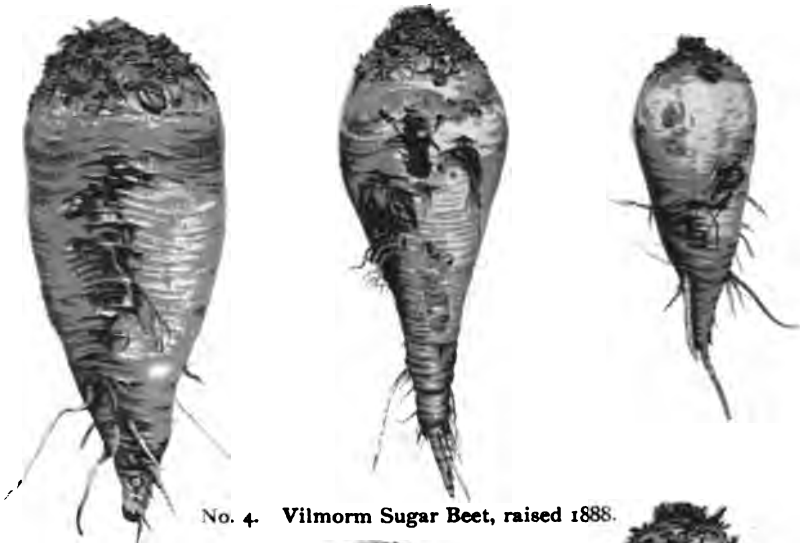
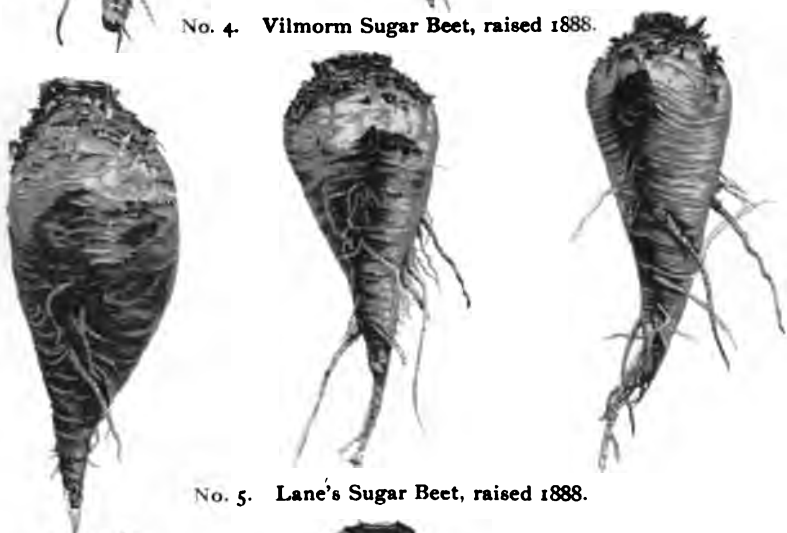


No. 4. Vilmorm Sugar Beet, raised 1888.



No. 5. Lane's Sugar Beet, raised 1888.

No. 6. New Market Gardener Beet, raised 1888.

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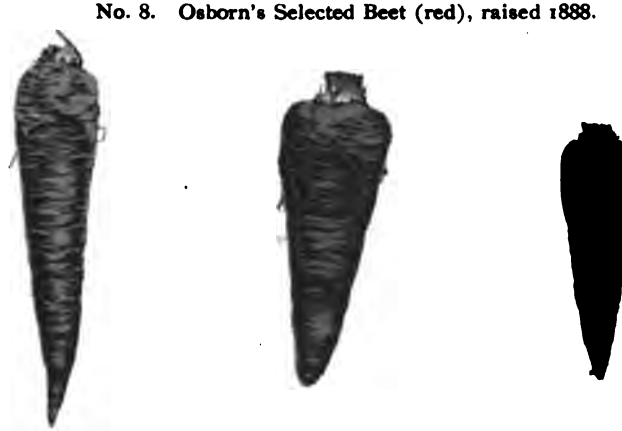
No. 7. Eclipse Beet (red), raised 1888.

No. 8. Osborn's Selected Beet (red), raised 1888.



No. 9. Danver's Carrot (yellow), raised 1888.

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The crop was harvested October 22. The entire season was remarkable for its exceptional coolness in July, and its abundance of rain. The leaves retained even to the time of harvesting a considerable degree of vitality.

Carrots (*Danver's Yellow*). — This crop occupied an area of 109 by 70 feet; the field was manured in the same way and with the same quantity of fine-ground bones and muriate of potash as the one which served for the raising of the above-mentioned varieties of roots. The soil was in both instances practically of a corresponding character, and in a corresponding state of fertilization. The seed was planted in rows, fourteen inches apart, June 1. The young plants appeared above ground June 17; the crop was kept clean from weeds by the use of the hand and the cultivator. The roots were harvested October 31; they amounted to 6,850 pounds, or 137 bushels, at 50 pounds each, which is equal to 19.52 tons per acre.

Samples of all the varieties of roots raised at the Station have been carefully collected and at once photographed, to present a concise idea of their peculiarity, as far as their exterior is concerned. Analyses of each kind will be presented later on. Three samples of every variety, representing the largest, middle and smallest size of each, served the photographer. The picture was in each case taken at a corresponding distance, to allow comparison of size. The weight of each is also stated.

TABULAR STATEMENT OF WEIGHTS OF ROOTS PHOTOGRAPHED.

	Largest.	Medium.	Smallest.
Picture No. 1. Saxony Sugar Beet,*	–	–	–
" 2. Excelsior Sugar Beet, ...	2 lbs. 14 oz.	1 lb 15 oz.	1 lb. 5 oz.
" 3. Improved Imperial Sugar Beet, .	4 " 4 "	2 " 4 "	1 " 5 "
" 4. Vilmorin Sugar Beet, ...	5 " 0 "	2 " 7 "	1 " 2 "
" 5. Lane's Sugar Beet, ...	2 " 15 "	1 " 9 "	1 " 7 "
" 6. New Market Gardener Beet, . .	4 " 7 "	3 " 14 "	1 " 14 "
" 7. Eclipse Beet, ...	2 " 11 "	1 " 13 "	0 " 12 "
" 8. Osborn's Selected Beet, ...	2 " 11 "	1 " 9 "	1 " 2 "
" 9. Danver's Carrot, ...	0 " 13 "	0 " 11 "	0 " 6 "

* Total weight of 3 sizes, 8 lbs. 12 oz.

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VI. Notes on Miscellaneous Field Work.

Aside from the strictly experimental work on our older field, much preparatory work has been carried on during the past year on our more recent addition of lands. The older field, which has been for six years under our control, is located along the west side of the highway leading from Amherst to North Amherst; it covers an area of about twenty acres, including the grounds occupied by the present buildings of the Experiment Station. The more recent addition of lands (1886) is located along the east side of the highway; it covers an area of thirty acres, of which ten acres are occupied by a natural forest growth. The entire field forms the western slope of a prominent elevation. Most of the cultivated portion, which consisted of old grass lands, is gradually slanting towards the north-west, while a considerable portion of it is nearly on a level, with a slight depression towards the north. The entire area, consisting essentially of a good gravelly loam, admits of a satisfactory management of the work to be carried on upon it. The steeper portion along the wood land will be used for experiments with large and small fruits, the adjoining part towards the west for experiments with general farm crops, and the more level western termination for permanent grass lands. This plan for its future use was adopted after taking possession of the grounds in 1886.

As the lands along the slope are somewhat springy, and as its lower portion has at times to convey to the north a considerable amount of water coming from adjoining southern hillsides, a thorough system of underdraining was at once devised, and in its essential direction carried out, before any of the sod was turned over. Subsequently, during the autumn of 1886, the northern end of the entire field, to the extent of twelve acres, was ploughed; while the ploughing of the southern terminus of the field, comprising eight acres of old grass land, was for financial considerations reserved for a year later (1887).

The ploughed lands were thoroughly treated with a wheel harrow during the succeeding spring, before planting. Wood

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ashes, at the rate of one ton per acre, was the only fertilizer used during the first season. This mode of manuring these lands was adopted for the purpose of assisting in a rapid decomposition of a rank growth, and of bringing the soil, as far as practicable, to a corresponding state of fertilization in the interest of future experiments. A variety of crops was subsequently planted, with the main aim to secure, in every instance, a thorough mechanical working of the soil by drill cultivation or by the use of the hoe. Several varieties of barley and of oats, corn, potatoes, squashes, and a variety of other garden crops, occupied the field. The periodical stirring of the soil promised to free the land from a foul growth, which in the course of time naturally overruns old grass lands.

During the month of September about seven acres of the entire cultivated area were prepared for a permanent meadow, and seeded down with a mixture of herd's grass and red-top; some varieties of clover were added the succeeding spring (1888).

The southern end of the field, which had still served, as above stated, for the production of hay, was turned over late in the season, to be prepared during the succeeding spring for future experiments in the same manner as the north end.

1888. — The preparatory work has been continued in all parts of this field. The exceptional rainfall has seriously tested the capacity of our drain tiles; they have stood the test, on the whole, satisfactorily. Needed alterations have been attended to, and the prospects are that no further serious trouble may be expected. No fertilizers but wood ashes have been used thus far. Drill cultivation has been generally adopted, to assist in future cultivation. Several acres of oats, barley and corn have been raised, to assist in the support of feeding experiments. The permanent grass lands have been increased here to from nine to ten acres. Definite grass mixtures have been used as seed, to test their respective merits in our locality. The results will be carefully watched, from a botanical as well as from an economical stand-point. An orchard will be laid out during the coming year.

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The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the Station, or engaged in a course of preparation for future experiments: —

	Tons
Good English hay,	23
Rowen,	9
Corn stover,	3½
Corn fodder,	4½
Roots (carrots and sugar beets),	7
Oats (grain and straw),	4¼
Barley (grain and straw),	2
Green fodder (vetch, oats and cow-pea),	4½
Crops for ensilage (corn, 9½ tons; Soja bean, cow-pea and Hungarian grass, 3½ tons),	13
Potatoes (mainly Beauty of Hebron, Early Rose and Polaris), 260 bush.	

From four to five acres of Southern cow-pea, Soja bean, horse bean, lupine and buckwheat have been subjected to drill cultivation, for the purpose of renovating old grass lands and to serve ultimately as green manure.

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NEW LAWS

FOR THE

REGULATION OF THE SALE OF COMMERCIAL FERTILIZERS.

WORK IN THE CHEMICAL DEPARTMENT.

I. FERTILIZER LAWS AND FERTILIZER ANALYSES.

II. MISCELLANEOUS ANALYSES.

The Legislature of 1888, at the suggestion of the State Board of Agriculture, has enacted a new law, entitled, "An Act to regulate the Sale of Commercial Fertilizers," chapter 296. This Act, which has been in operation since Sept. 1, 1888, assigns the supervision of the sale of commercial fertilizers to the director of the Massachusetts State Agricultural Experiment Station at Amherst, Mass.

The provisions of the Act are as follows: —

[Chap. 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Be it enacted, etc., as follows:

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes, sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers

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which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients, namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, or offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence and one hundred dollars for each subsequent offence.

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SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in presence of said party or parties in interest or their representative, and taken from a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples, and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be made substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

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The above-stated regulations are now in force, and a compliance with them is imperative on all manufacturers, importers, agents or sellers of any brand of commercial fertilizer or of any material used for manurial purposes, the retail selling price of which is ten dollars or more per ton.

It will be noticed that the new provisions for the control of the trade in fertilizers in Massachusetts apply not only, as heretofore, to a certain class of more or less compound, distinct brands of commercial fertilizers, but to all materials, single or compound, used for manurial purposes, without regard to source, when offered for sale at ten dollars or more per ton.

The official report of analyses and of all materials used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted to a statement of chemical composition, and to such additional information as relates to the former. This change, it is expected, will tend to direct the attention of the consumer of fertilizers more towards the composition of the different brands of fertilizers offered for sale.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. Those who are not yet familiar with the current market value of fertilizing constituents may benefit by a short discussion of that subject at the close of this chapter.

The approximate market value of different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value. The higher or lower market price of different brands of fertilizer does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crop to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage requires in the main two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question contains the guaranteed quantities and qualities of essential articles of plant

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food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some instances it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the previously stated considerations.

The new duties assigned to the director of the Station render it necessary to discriminate in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

More detailed information in this connection, regarding the duties of the director of the Massachusetts State Agricultural Experiment Station, and the obligations of the manufacturers, dealers and agents engaged in the sale of commercial fertilizers or materials used for manurial purposes, may be obtained by addressing the director at Amherst, Mass. Copies of the above-printed Act may be had on application.

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I.—Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
1	"Americus" Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Springfield.
2	"Americus" Potato Fertilizer,	" " " "	"
3	H. L. Phelps' Complete Manure; Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
4	H. L. Phelps' Phosphate,	" " " "	"
5	H. L. Phelps' Complete Manure for Corn and Grain,	" " " "	"
6	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
9	Crocker's Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
10	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Co., New York City,	"
12	Mapes' Potato Manure,	" " " " "	"
14	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
15	Stockbridge's Manure for Vegetables,	" " " "	"
20	Randall's Combined Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
23	Crocker's Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	Concord.
24	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
25	Allen Fertilizer,	American Manufacturing Co., Boston, Mass.,	"
26	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	"
60	Swan Island Guano,		Springfield.
61	Hargrave's Ground Bone,	Hargrave Manufacturing Co., Fall River, Mass.,	Amherst.
62	Cotton-seed Hull Ashes,		Whately.
63	Cotton-seed Hull Ashes,		South Deerfield.

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TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
1	"Americus" Ammoniated Bone Superphosphate,	14.87	2.91	2-3	9.63	0.61	0.41	10.65	11-13	10.24	10-12	2.54	2-3*
2	"Americus" Potato Fertilizer,	10.85	3.97	3-4	6.35	1.01	1.63	8.99	7-8	7.36	6-8	7.94	8-10*
3	H. L. Phelps' Complete Manure; Guano and Potash,	8.94	6.50	3.3-4.1	3.34	2.39	3.26	8.99	-	5.73	4-5	6.12	5-7
4	H. L. Phelps' Phosphate,	9.75	3.71	2.5-3.3	5.46	2.98	2.70	11.14	10-12	8.44	-	3.75	3-4
5	H. L. Phelps' Complete Manure for Corn and Grain,	9.74	4.07	4.1-5	5.83	1.64	4.47	11.94	8-10	7.47	6-8	7.19	7-8
6	Bradley's XL Superphosphate of Lime,	14.57	3.03	2.5-3.25	9.44	0.64	3.71	13.79	11-14	10.08	9-11	1.84	2-3*
9	Crocker's Potato, Tobacco and Hop Phosphate,	13.32	2.71	2-3	8.01	3.01	2.29	13.31	8-12	11.02	8-12	4.09	3.5-4.5*
10	Mapes' Corn Manure,	12.73	4.40	3.7-4.1	6.66	2.37	4.42	13.45	10-12	9.03	-	6.36	6-7
12	Mapes' Potato Manure,	9.98	4.08	3.7-4.4	4.22	3.53	6.18	13.93	8-10	7.75	6-8	6.72	6-8*
14	Bowker's Hill and Drill Phosphate,	13.06	3.27	2.5-3.25	7.84	2.98	2.31	13.13	11-14	10.82	10-12	2.25	2-3*
15	Stockbridge's Manure for Vegetables,	11.03	3.77	3.25-4.25	6.21	3.11	1.68	11.00	-	9.32	8-10	4.04	5-6
20	Randall's Combined Bone and Potash,	12.33	2.33	1.6-2.5	2.29	5.10	7.04	14.43	13-16	7.39	5-7	2.44	2-3
23	Crocker's Ammoniated Bone Superphosphate,	11.32	3.20	2.9-3.7	7.87	1.01	2.92	11.80	-	8.88	8-12	1.22	1-3*
24	Standard Superphosphate,	10.85	3.56	2.25-3.25	9.05	1.92	3.04	14.01	11-16	10.97	9-13	1.83	2-4
25	Allen Fertilizer,	21.14	2.50	2.0-3.1	5.45	2.47	1.79	9.71	6-10	7.92	5-8	5.19	4-6
26	Darling's Animal Fertilizer,	17.08	4.08	3.3-5	2.67	2.04	5.84	10.55	10-12	4.71	-	4.16	4-6
60	Swan Island Guano,	14.97	0.52	-	-	4.15	16.77	20.92	-	4.15	-	0.89	-
61	Hargrave's Ground Bone,	12.43	2.68	3.93	0.13	6.20	19.34	25.67	18.8	6.33	4-12	-	-
62	Cotton-seed Hull Ashes,	8.90	-	-	-	-	-	9.76	-	-	-	26.66	-
63	Cotton-seed Hull Ashes,	10.15	-	-	-	-	-	15.37	-	-	-	19.07	-

* Sulphate of potash, the source of potash.

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TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
27	Standard Superphosphate,	Standard Fertilizer Co., Boston, Mass.,	Boston.
30	Soluble Pacific Guano,	Pacific Guano Co., Boston, Mass.,	Concord.
35	Darling's Lawn Dressing,	L. B. Darling Fertilizing Co., Pawtucket, R. I.,	Boston.
36	Cumberland Superphosphate,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
38	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	North Hadley.
39	Chittenden's Complete Fertilizer for Potatoes,	" " " " "	South Deerfield.
40	Pequot Fish and Potash,	Quinnipiac Co., New London, Conn.,	"
42	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Plymouth.
45	Baker's A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York City, N. Y.,	New Bedford.
49	Tucker's Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Taunton.
52	Original Bay State Bone Superphosphate,	" " " "	W. Bridgewater.
53	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
54	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	"
67	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	E. Frank Coe, New York City, N. Y.,	Lowell.
74	Dole's 203 Fertilizer,	Dole Fertilizer Co., Boston, Mass.,	"
77	E. Frank Coe's Alkaline Bone,	E. Frank Coe, New York City, N. Y.,	"
85	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
115	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Co., Boston, Mass.,	Mendon.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Swansea.

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TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
27	Standard Superphosphate,	14.86	3.41	2.25–3.25	8.60	2.09	2.94	13.63	11–16	10.69	9–13	2.96	2–4
30	Soluble Pacific Guano,	12.54	2.97	2.25–3	7.16	1.58	3.54	12.28	10.5–16	8.74	8.5–12	3.21	2–3.5
35	Darling's Lawn Dressing,	19.85	5.25	5–6.5	2.12	3.88	4.05	10.05	9–11	6.00	–	5.20	4–6
36	Cumberland Superphosphate,	14.55	2.89	2–4	6.17	2.95	3.58	12.70	12–14	9.12	9–13	2.57	2–3
38	Chittenden's Complete Tobacco Fertilizer,	9.45	3.07	3.3–5	3.87	5.28	3.45	12.60	8–10	9.15	6–8	4.26	*
39	Chittenden's Complete Fertilizer for Potatoes,	11.44	3.23	3.2–4.2	4.51	3.94	2.97	11.42	8–10	8.45	6–8	5.75	6–8
40	Pequot Fish and Potash,	23.25	3.40	2.5–3.3	0.35	3.37	2.11	5.83	–	3.72	3–5	4.22	4–6*
42	Soluble Pacific Guano,	14.20	3.00	2.25–3	7.87	1.11	1.77	10.75	10.5–12	8.98	8.5–12	2.29	2–3.5
45	Baker's A. A. Ammoniated Superphosphate,	19.32	3.40	1.7–3.2	10.40	1.23	0.14	11.77	–	11.63	10–12	3.18	2–3
49	Tucker's Imperial Bone Superphosphate,	21.29	2.45	2–2.5	5.98	1.73	2.70	10.41	9–10	7.71	7–8	2.98	*
52	Original Bay State Bone Superphosphate,	18.78	3.00	2.5–2.9	7.20	1.57	2.40	11.19	10–12	8.79	9–9.5	1.38	2–3
53	Darling's Fine Ground Bone,	5.79	2.95	3.5–4.5	–	7.42	17.31	24.73	22–25	7.42	–*	–	–
54	Dow's Nitrogenous Superphosphate,	16.88	2.76	2.1–2.9	4.80	3.90	2.16	10.86	8–10	8.70	–	2.57	–
67	The Lawrence Fertilizer,	13.51	1.86	2.1–2.9	8.85	2.78	2.57	14.20	10–12	11.63	–	4.21	6
68	E. Frank Coe's High Grade Am. Bone Superphosphate,	9.42	2.62	2–2.5	8.37	1.51	2.17	12.05	11–13	9.88	9–12	2.34	*
74	Dole's 203 Fertilizer,	11.14	3.12	3–4	4.16	2.88	3.80	10.84	10–12	7.04	8–10	3.09	3–4
77	E. Frank Coe's Alkaline Bone,	10.24	1.94	0.8–1.6	8.64	1.42	1.97	12.03	11–15	10.06	9–12	2.77	*
85	Great Eastern General Fertilizer,	12.35	2.95	2.9–3.7	5.37	3.31	2.58	11.26	9–15	8.68	8–12	2.01	2–4
115	Bradley's Complete Manure for Potatoes and Vegetables,	15.24	3.93	3.7–4.5	8.96	2.78	1.44	13.12	9–12	11.74	8–10	6.57	6–7
117	Brightman's Fish and Potash,	27.11	3.22	2.5–4.1	0.69	2.87	2.23	5.79	6.9	3.56	–	2.67	2–3

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TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
8	Bradley's Dry Fish Guano,	Bradley Fertilizer Co., Boston, Mass.,	Northampton.
31	Americus Ammoniated Bone Superphosphate,	Williams & Clark Co., New York City, N. Y.,	Concord.
43	Bay State Fertilizer,	Clark Cove Guano Co., New Bedford, Mass.,	Plymouth.
64	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
66	Common Sense Fertilizer,	Common Sense Fertilizer Co., Boston, Mass.,	Haverhill.
80	Lowell Bone Fertilizer,	Josiah M. Butman, Lowell, Mass.,	Chelmsford.
81	Jefferds' Animal Fertilizer,	John Jefferds, Worcester, Mass.,	Greenfield.
82	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.,	"
87	Orient Complete Manure,	Orient Guano Manufacturing Co., Long Island, N. Y.,	Lee.
91	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
95	E. Frank Coe's Potato Fertilizer,	E. Frank Coe, New York City, N. Y.,	Westfield.
118	Chittenden's Complete Tobacco Fertilizer,	National Fertilizer Co., Bridgeport, Conn.,	South Deerfield.
119	N. Ward's High Grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
120	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Weston.
121	Whittemore Bros.' Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
124	Economic Fertilizer, No. 3,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
127	Cleveland's Superphosphate,	Cleveland Dryer Co., Boston, Mass.,	Lowell.
128	Lister's Success Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	"
17	Williams & Clark Co.'s Potato Phosphate,	Williams & Clark Co., New York City, N. Y.,	Worcester.
32	Bradley's XL Superphosphate,	Bradley Fertilizer Co., Boston, Mass.,	Westborough.
109	Pacific Guano Co.'s Fish and Potash,	Pacific Guano Co., Boston, Mass.,	South Amherst.
130	Cotton-seed Hull Ashes,		Boston.

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TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
8	Bradley's Dry Fish Guano,	7.25	8.83	8.2–9.9	0.41	2.91	3.05	6.37	6–8	3.32	–	–	–
31	Americus Ammoniated Bone Superphosphate,	15.09	3.26	2–3	9.07	1.52	–	10.59	11–16	10.59	10–12	2.71	2–3
43	Bay State Fertilizer,	12.07	3.22	2.1–2.8	8.24	0.98	1.50	10.72	9.5–14	9.22	9–11	2.51	2–3
64	Ames' Bone Fertilizer,	16.76	4.02	3.3–4.5	5.94	4.04	1.02	11.00	11–13	9.98	–	0.98	1
66	Common Sense Fertilizer,	11.14	1.74	2–4	0.03	7.16	2.53	9.72	9–14	7.19	–	1.83	1–2
80	Lowell Bone Fertilizer,	9.88	2.65	2–3	4.96	6.51	2.03	13.50	10–14	11.47	6–10	2.94	2–4
81	Jefferds' Animal Fertilizer,	5.39	3.88	4.1–5.8	0.18	6.15	11.19	17.52	14–16	6.33	–	6.04	5–7
82	Crocker's Potato, Hop and Tobacco Phosphate,	7.71	2.65	2–3	8.50	0.85	1.00	10.36	9–14	9.35	8–12	4.04	3.5–4.5*
87	Orient Complete Manure,	14.11	2.54	1.7–2.5	7.52	1.53	–	9.05	10–17	9.05	8–12	1.87	1–2.5*
91	Adams' Market Bone Fertilizer,	12.67	4.10	2.5–3.5	1.30	6.14	3.64	11.08	8–10	7.44	6–8	4.52	3–5
95	E. Frank Coe's Potato Fertilizer,	14.64	1.91	1.7–2.5	7.87	0.81	1.57	10.25	–	8.68	8–10	3.71	*
118	Chittenden's Complete Tobacco Fertilizer,	10.08	3.16	3.3–5	5.42	4.94	1.58	11.94	8–10	10.36	6–8	6.38	*
119	N. Ward's High Grade Animal Fertilizer,	14.43	3.69	2.88–3.7	5.69	5.37	1.41	12.47	–	11.06	12–14	3.89	4–5
120	Mayo's Superphosphate,	9.33	2.61	2.5–3	8.03	1.78	1.80	11.61	11.5–13.5	9.81	10.5–11.5	3.27	3–4
121	Whittemore Bros.' Fertilizer,	17.65	2.38	2.5–3.3	6.91	5.99	0.90	13.80	–	12.99	8–12	3.81	3–4
124	Economic Fertilizer, No. 3,	9.33	0.27	0.25–0.75	0.06	1.63	9.13	10.82	6–9	1.69	–	0.13	–
127	Cleveland Superphosphate,	7.73	2.71	2.05–2.55	7.74	3.19	3.18	14.11	10–13	10.93	8–10	2.14	3–4*
128	Lister's Success Fertilizer,	13.15	1.87	1.2–1.7	6.68	3.17	2.57	12.42	–	9.87	10.5–12	1.50	1.5–2*
17	Williams & Clark Co.'s Potato Phosphate,	14.46	3.03	2–3	7.24	2.30	5.94	15.48	8–10	9.54	7–10	5.61	6–8*
32	Bradley's XL Superphosphate,	15.78	3.07	2.5–3.25	7.26	2.87	2.12	12.25	11–14	10.13	9–11	1.99	2–3*
109	Pacific Guano Co.'s Fish and Potash,	13.90	2.65	2.5–3.3	3.44	3.05	3.12	9.61	6–9	6.49	4–7	5.28	4–6
130	Cotton-seed Hull Ashes,†	6.51	–	–	–	–	–	3.11	–	–	–	17.37	–

* Sulphate of potash, the source of potash. † Insoluble matter, 39.29 per cent., exceptionally large.

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TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
21	Randall's Market Garden Fertilizer,	Benjamin Randall, Boston, Mass.,	Boston.
22	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Co., Boston, Mass.,	Concord.
34	Breck's Lawn and Garden Dressing,	Standard Fertilizer Co., Boston, Mass.,	Boston.
69	Darling's Pure Dissolved Bone Superphosphate,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Ipswich.
71	The Allen Fertilizer for Corn,	American Manufacturing Co., Boston, Mass.,	Reading.
86	E. Frank Coe's High Grade Fish Guano and Potash,	E. Frank Coe, New York City, N. Y.,	Westfield.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Pittsfield.
99	H. Preston & Son's Ammoniated Bone Superphosphate,	H. Preston & Son, Greenpoint, Long Island,	"
104	Quinnipiac Phosphate,	Quinnipiac Fertilizer Co., New London, Conn.,	Williamstown.
107	Pacific Guano Co.'s Fish and Potash,	Glidden & Curtis, Boston, Mass.,	"
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	Geo. W. Miles, Milford, Conn.,	Amherst.
122	Bartlett's Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
129	Lister's Celebrated Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Lowell.
131	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	Somerset.

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TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Randall's Market Garden Fertilizer,	14.52	3.83	2.9–3.3	4 61	3.24	2.25	10.10	–	7.85	8.5–11	4.12	4–5
22	Stockbridge's Manure for Strawberries,	10.90	3 38	2.88–3.7	4 16	2.96	4.55	11.67	7–9	7.12	6–7	3.29	4–5
34	Breck's Lawn and Garden Dressing,	8.68	5.42	4.1–5	6.54	1.94	1.34	9.82	–	8.48	8–9	4 67	4–6
69	Darling's Pure Dissolved Bone Superphosphate,	11.01	2.40	2.06–2.47	6.12	10.45	1.16	17.73	16–18	16.57	15–17	–	–
71	The Allen Fertilizer for Corn,	20.77	2.42	2.06–3 09	4.54	1.72	1.44	7.70	6–10	6.26	5–8	2.91	4–6
86	E. Frank Coe's High Grade Fish Guano and Potash,	12.07	2.66	3.3–4.1	2.08	2.36	5.25	9.69	–	4.44	6–8	3.26	*
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	12.07	2.95	2.06–2.88	6.05	2.42	2.09	10.57	9–15	8.47	8–12	5.98	6–8
99	H. Preston & Son's Ammoniated Bone Superphosphate,	15.12	2.50	2.47–3 3	5.04	2.24	3.42	10.70	–	7.28	9–10	1.86	2–3
104	Quinnipiac Phosphate,	15.69	3.23	2.75–3.25	8.11	2.20	1.11	11.24	–	10.31	9–12	2.34	2–3*
107	Pacific Guano Co.'s Fish and Potash,	11.78	3.47	2.47–3.3	4.27	1.94	2.64	8.85	6–9	6.21	4–7	6.55	4–6
108	Geo. W. Miles' IXL Ammoniated Bone Superphosphate,	19.18	2.27	2.06–3.3	7.75	1.69	1.10	10.54	–	9.44	8–12	2.20	1–3
122	Bartlett's Bone,	4.41	2.28	–	0.25	15.78	13.79	29 82	–	16.03	–	–	–
129	Lister's Celebrated Bone,	10.62	3.51	2.7–2.9	0.51	9.29	3.13	12.93	12–14	9.80	–	–	–
131	Church's Fish and Potash,	26 55	3.62	3.71–4.12	1.62	2.32	0.79	4.91	5–6	3.94	–	4.28	3.5–4*

* Sulphate of potash, the source of potash.

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TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
16	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Co., Boston, Mass.,	Worcester.
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	" " " "	Ware.
29	Stockbridge's Manure for Potatoes,	" " " "	"
37	Seeding Down Fertilizer,	Cumberland Bone Co., Portland, Me.,	Fitchburg.
41	Quinnipiac Dry Ground Fish,	Quinnipiac Fertilizer Co., New London, Conn.,	South Deerfield.
46	Baker's Complete Grass Manure,	H. J. Baker & Bro., New York City,	New Bedford.
47	Baker's Special Corn Fertilizer,	" " " "	"
51	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	Cochesett.
55	Brightman's Dry Ground Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	"
56	Brightman's Fish and Potash,	" " " "	"
58	Dow's Grass Fertilizer,	John C. Dow & Co., Boston, Mass.,	"
65	Farmers' New Method Fertilizer,	Bradley Fertilizer Co., Boston, Mass.,	Newburyport.
70	The Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
76	The Lawrence Fertilizer,	" " " "	"
83	Jefferds' Fine Ground Bone,	John Jefferds, Worcester, Mass.,	Greenfield.
84	Adams' Market Bone Fertilizer for Potatoes,	Adams & Thomas, Springfield, Mass.,	Springfield.
88	Church's Fish and Potash,	Jos. Church & Co., Tiverton, R. I.,	"
123	Economic No. 1,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.

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TABLE I. — *Continued.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
16	Stockbridge's Manure for Seeding Down,	12.81	3.20	2.5–3.3	4.22	2.91	6.40	13.53	–	7.13	14–15	3.22	4–5
28	Stockbridge's Manure for Grass, Top Dressing and Forage Crops,	15.23	5.28	5.5–6.5	3.94	1.67	4.61	10.22	6–8	5.61	5–6	2.85	2.5–3.5
29	Stockbridge's Manure for Potatoes,	10.38	3.98	3.25–4.25	5.90	2.23	2.59	10.72	9–11	8.13	7–9	4.82	5–6
37	Seeding Down Fertilizer,	16.27	1.89	1.60	1.55	5.91	16.14	23.60	18–20	7.46	5–9	0.26	1
41	Quinnipiac Dry Ground Fish,	7.63	7.94	7.5–10	0.50	2.31	3.77	6.58	–	2.81	4–6	–	–
46	Baker's Complete Grass Manure,	18.50	4.34	3.71	5.28	0.62	–	5.90	–	5.90	5	7.68	7.5
47	Baker's Special Corn Fertilizer,	10.47	5.81	4.12	1.65	5.23	0.10	6.98	7.25–9.25	6.88	6.25	6.55	7
51	Darling's Animal Fertilizer,	15.07	3.48	3.3–4.94	2.70	4.90	2.92	10.52	10–12	7.60	–	4.95	4–6
55	Brightman's Dry Ground Fish Guano,	14.02	7.18	8.24–9.89	0.38	2.30	6.22	8.90	6.8–9.16	2.68	–	–	–
56	Brightman's Fish and Potash,	23.59	2.90	2.5–4.1	1.48	2.21	1.08	4.77	6.8–8.2	3.69	2–3	3.35	2–3
58	Dow's Grass Fertilizer,	12.48	3.50	3.3–4.12	0.72	2.75	7.52	10.99	12–14	3.47	–	3.04	2–3
65	Farmers' New Method Fertilizer,	14.90	1.32	0.82–1.82	8.60	0.93	1.06	10.59	10–12	9.53	8–10	1.50	*
70	The Lawrence Fertilizer,	13.29	1.73	2.06–2.88	8.28	2.38	2.97	13.63	10–12	10.66	–	4.86	10
76	The Lawrence Fertilizer,	12.62	1.67	2.06–2.88	9.60	2.66	2.94	15.20	10–12	12.26	–	0.58	2–3
83	Jefferds' Fine Ground Bone,	9.03	1.86	2.47–3.3	0.13	7.73	21.68	29.54	27–30	7.86	–	–	–
84	Adams' Market Bone Fertilizer,	9.58	3.95	2.5–3.5	1.38	4.34	5.47	11.19	8–10	5.72	6–8	5.30	3–5
88	Church's Fish and Potash,	26.48	2.48	3.71–4.12	1.91	2.74	0.35	5.00	5–6	4.65	–	4.22	3.5–4*
123	Economic No. 1,	11.68	1.71	1–2	–	0.61	4.22	4.83	2–4	0.61	–	0.19	–

* Sulphate of potash, the source of potash.

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TABLE I. — *Continued.*

Laboratory No.	Name of Brand.	Name of Manufacturer.	Sampled at.
7	Bone and Potash (Circle Brand),	Bradley Fertilizer Co., Boston, Mass.,	Springfield.
33	Randall's Farm and Field,	Benj. Randall, Boston, Mass.,	Boston.
59	Dow's Ground Bone,	J. C. Dow & Co., Boston, Mass.,	Cochesett.
75	Unicorn Brand Ammoniated Superphosphate,	Clark's Cove Guano Co., New Bedford, Mass.,	Ipswich.
78	Bradley's Sea Fowl Guano,	Bradley Fertilizer Co., Boston, Mass.,	"
89	World of Good Tobacco Grower,	Thomson & Edwards Fertilizer Co., Chicago, Ill.,	North Hatfield.
90	Original Coe's Superphosphate of Lime,	Bradley Fertilizer Co., Boston, Mass.,	Shelburne Falls.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
93	Great Eastern General Fertilizer,	Great Eastern Fertilizer Co., Rutland, Vt.,	Glendale.
100	Chittenden's Universal Phosphate,	National Fertilizer Co., Bridgeport, Conn.,	Pittsfield.
101, 105, 112	Soluble Pacific Guano,	Glidden & Curtis, Agents, Boston, Mass.,	Williamstown.
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Co., New York,	Great Barrington.
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	E. Frank Coe, New York,	North Adams.
110	Geo. W. Miles' Fish and Potash Manure,	Geo. W. Miles, Milford, Conn.,	Amherst.
125	Economic No. 4, for Potatoes,	Economic Fertilizer Co., Boston, Mass.,	Charlestown.
132	Darling's Fine Ground Bone,	L. B. Darling Fertilizer Co., Pawtucket, R. I.,	
134	Cotton-seed Hull Ashes,		Granby.

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TABLE I. — *Concluded.*

Laboratory No.	Brand.	Moisture.	Nitrogen in 100 Pounds.		Phosphoric Acid in 100 Pounds.							Potassium Oxide in 100 Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
7	Circle Brand of Bone and Potash,	8.04	2.05	1.9–2.6	2.98	4.08	6.55	13.61	8–12	7.06	–	1.72	2–3
33	Randall's Farm and Field,	19.34	2.50	1.6–2.7	4.99	2.65	1.57	9.21	10–16	7.64	8–11	2.20	2–4
59	Dow's Ground Bone,	9.11	2.76	2.06–2.47	0.67	3.20	13.97	17.84	18–22	3.87	–	1.95	3–4
75	Unicorn Brand Ammoniated Superphosphate,	12.91	2.37	1.8–2.5	4.67	2.05	3.79	12.51	10–13	8.72	8.5–10	3.40	2.25–3
78	Bradley's Sea Fowl Guano,	16.55	2.41	2.5–3.25	8.25	2.70	2.03	12.98	11–14	10.95	9–11	1.90	2–3*
89	World of Good Tobacco Grower,	6.81	1.66	3.30–4.11	5.85	1.57	4.73	12.15	10–12	7.42	–	1.35	*
90	Original Coe's Superphosphate of Lime,	14.82	3.36	2.05–2.25	7.28	2.96	1.25	11.49	10–13	10.24	8–10	1.18	1–2*
92	Chittenden's Ammoniated Bone Superphosphate,	13.81	2.41	1.5–2.47	5.44	2.43	5.18	13.05	9–11	7.87	7–9	2.78	2–4
93	Great Eastern General Fertilizer,	13.09	3.74	2.88–3.71	5.22	3.50	2.81	11.53	9–15	8.72	8–12	1.87	2–4
100	Chittenden's Universal Phosphate,	8.48	2.73	2.06–2.88	2.21	4.99	8.54	15.74	11–12	7.20	9–11	3.20	2–3
101, 105, 112	Soluble Pacific Guano,	11.51	3.23	2.25–3	6.26	2.89	2.67	11.82	10.5–16	9.15	8.5–12	1.97	2–3.5
102	Williams & Clark Co.'s Ammoniated Bone Superphosphate (Americus Brand),	13.57	3.22	2–3	6.78	2.97	0.49	10.24	11–16	9.75	8–9	3.78	2–3*
103	E. Frank Coe's High Grade Ammoniated Superphosphate,	10.72	2.52	2–2.5	7.80	1.27	2.83	11.90	11–13	9.07	9–12	2.16	*
110	Geo. W. Miles' Fish and Potash Manure,	13.45	3.02	2.47–4.12	5.37	2.91	1.31	9.59	7–10	8.28	6–7	4.46	3–5
125	Economic No. 4, for Potatoes,	12.15	0.69	0.25–0.75	0.25	0.84	5.28	6.37	2–4.5	1.09	–	0.56	–
132	Darling's Fine Ground Bone,	8.12	3.60	3.5–4.5	0.17	9.12	14.75	24.13	22–25	9.29	–	–	–
134	Cotton-seed Hull Ashes,	13.50	–	–	–	–	–	8.83	–	–	–	20.97	–

* Sulphate of potash, the source of potash.

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II.—Analysis of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I. Sent on from Ipswich, Mass. II. and III. Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.24	14.50	14.13
Calcium oxide,	38.30	33.34	33.45
Magnesium oxide,	2.82	3.83	3.39
Potassium oxide,	2.55	5.76	6.32
Phosphoric acid,	1.83	1.28	1.40
Insoluble matter (before calcination),	21.58	14.96	14.83
Insoluble matter (after calcination),	19.81	9.95	11.67

Sample I. contains but one-half the amount of potash of an ordinary quality of Canada wood ash. Samples II. and III. are of a good quality, and correspond fairly with the guaranty of the dealer. The question has been repeatedly asked, on what basis to adjust differences between a stated guaranty of composition and the actual results of an analysis of a sample of wood ash. Our answer has been, in these cases, to allow 5½ cents for every pound of potassium oxide and 6 cents for every pound of phosphoric acid which the analysis shows to be less than the guaranty states to be present.

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Wood Ashes.

[I. Sent on from Amherst, Mass. II. Sent on from Amherst, Mass. III. Sent on by F. H. Greeley, Salisbury, Mass. IV. Sent on by J. D. W. French, North Andover, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.67	19.14	7.29	17.14
Phosphoric acid,	1.25	1.72	3.09	5.04
Calcium oxide,	39.06	30.16	45.22	35.59
Potassium oxide,	5.38	4.76	4.37	4.22
Magnesium oxide,	2.88	3.04	4.27	6.45
Insoluble matter (before calcination),	17.42	21.72	18.14	17.47
Insoluble matter (after calcination),	8.79	13.45	11.23	12.19

[V. Sent on by C. F. Clark, Boston, Mass. VI. Sent on by Coolidge Bros., South Sudbury, Mass. VII. and VIII. Sent on by Fred L. Ames, Boston, Mass.]

	Per Cent.			
	V.	VI.	VII.	VIII.
Moisture at 100° C.,	4.94	4.41	12.33	8.20
Phosphoric acid,	1.54	1.28	1.54	1.87
Calcium oxide,	31.70	35.50	34.17	40.15
Potassium oxide,	4.80	4.76	4.39	4.70
Magnesium oxide,	4.58	4.87	3.26	4.42
Insoluble matter (before calcination),	20.85	9.64	15.37	20.55
Insoluble matter (after calcination),	18.57	6.10	12.19	18.33

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Wood Ashes.

[I. Sent on by F. H. Williams, Sunderland, Mass. II. Sent on by C. H. Thompson & Co., Boston, Mass. III. and IV. Sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.31	2.57	8.67	19.14
Phosphoric acid,	1.65	1.53	1.25	1.72
Magnesium oxide,	2.41	5.29	2.88	3.04
Calcium oxide,	37.39	26.94	39.06	30.16
Potassium oxide,	7.78	7.95	5.38	4.76
Insoluble matter (before calcination),	10.93	17.44	17.42	21.76
Insoluble matter (after calcination),	6.15	15.66	8.79	13.45

Wood Ashes.

[I. Sent on by S. M. Farnsworth, Harvard, Mass. II. Sent on by J. J. H. Gregory, Marblehead, Mass. III. Sent on by D. G. Lang, Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	16.51	2.76	22.07
Phosphoric acid,	1.37	3.09	0.48
Magnesium oxide,	4.03	2.84	3.48
Calcium oxide,	32.54	32.03	29.11
Potassium oxide,	5.07	10 24	5.84
Insoluble matter (before calcination),	16.13	24.39	19.70
Insoluble matter (after calcination),	13.06	17.91	15.13

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Cotton-seed Hull Ashes.

[I. Sent on from Hatfield, Mass. II. Sent on from Agawam, Mass. III. Sent on from South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.26	7.15	10.19
Phosphoric acid (6 cts. per lb.),	8.83	8.06	15.37
Potassium oxide (5½ cts. per lb.),	24.13	28.22	19.07
Calcium oxide,	8.92	10.50	5.14
Magnesium oxide,	8.60	15.25	9.78
Insoluble matter (before calcination),	14.29	12.75	18.11
Insoluble matter (after calcination),	12.22	10.57	12.16
Valuation per 2,000 lbs,	$37.14	$40.71	$39.42

The samples are of an exceptionally good quality.

Cotton-seed Hull Ashes.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	6.95
Phosphoric acid,	3.14
Potassium oxide,	25.10
Calcium oxide,	12.41
Magnesium oxide,	5.84
Insoluble matter (before calcination),	55.48
Insoluble matter (after calcination),	9.58

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Potash Fertilizers.

[I. Muriate of Potash. II. Sulphate of Potash and Magnesia, sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.21	8.08
Potassium oxide,	49.77	21.88
Sodium oxide,	10.06	5.06
Calcium oxide,	2.07	3.54
Magnesium oxide,	0.45	11.93
Sulphuric acid,	0.55	43.43
Chlorine,	50.00	3.10
Insoluble matter,	0.17	0.77

Saltpetre Waste from Gunpowder Works.

[Sent on from Acton, Mass.]

	Per cent.
Moisture at 100° C.,	5.19
Potassium oxide,	15.04
Sodium oxide,	36.82
Total calcium oxide,	.47
Total magnesium oxide,	.27
Nitrogen,	1.90
Sulphuric acid,	1.02
Total chlorine,	53.50
Calcium chloride,	.05
Magnesium chloride,	.63
Insoluble matter,	Trace.

The composition of this material varies in different samples in a marked degree. Its application on forage crops and on grass lands in particular has proved highly satisfactory.

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Muck.

[I. and II. Sent on from Marlborough, Mass. III. Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	33.64	40.63	56.46
Dry matter,	66.36	59.37	43.54
Nitrogen in dry matter,	1.65	1.21	1.16
Ash constituents in dry matter,	6.44	18.73	4.72
Insoluble matter in ash,	5.76	15.07	Not determined.

These samples are fair representatives of their kind. As the agricultural value of this material has been repeatedly discussed in previous reports, no further statement seems to be called for.

Muck.

[I. and II. Sent on by A. A. Rice, Mount Hermon, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	30.26	75.44
Dry matter,	69.74	24.56
Nitrogen,	2.54	.37
Ash constituents in dry matter,	8.28	12.00

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Muck.

[Sent on by W. H. Earle, Worcester, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.030	11.231
Ash,	51.289	51.400
Ferric oxide,	Trace.	Trace.
Aluminic oxide,	6.672	6.953
Calcium oxide,	.038	.049
Magnesium oxide,	.030	.031
Potassium oxide,	.051	.062
Phosphoric acid,	.198	.232
Nitrogen,	1.470	1.460
Insoluble silicious matter,	39.755	39.635

Sea-weed.

[Sent on from Eastham, Mass., — two samples.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.05	14.96
Nitrogen (16½ cts. per lb.),	1.66	1.28
Phosphoric acid (6 cts. per lb.),	.44	.17
Potassium oxide (4¼ cts. per lb.),	3.81	.36
Calcium oxide,	2.73	3.86
Magnesium oxide,	1.48	1.30
Sodium oxide,	11.75	8.40
Chlorine,	6.40	5.28
Insoluble matter,	7.73	.78
Valuation per 2,000 lbs.,	$9.25	$4.72

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The samples were received in an air-dry state. According to statement, I. had been dried without any serious exposure to bad weather; II. had suffered from exposure for a considerable length of time.

Cotton-seed Meal (for manurial purposes).

[I. Sent on by Geo. Frost, Boston, Mass. II and III. Sent on by C. L. Warner, Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	6.26	8.30	8.30
Ash,	6.16	5.77	5.77
Calcium oxide,	.31	.31	.31
Magnesium oxide,	.95	.77	.77
Potassium oxide,	1.80	1.21	.89
Phosphoric acid,	1.32	1.45	1.26
Nitrogen,	7.26	6.69	6.88
Insoluble matter,	.53	.40	.40

Refuse Camel's Hair from Cotton-seed Oil Works.

[Sent on by W. H. Bowker, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.80
Ash,	7.25
Nitrogen,	5.92
Potassium oxide,	2.56
Phosphoric acid,	2.77
Insoluble matter,	1.27

Castor Pomace.

[Sent on by Benj. M. Warner, Hatfield, Mass.]

	Per cent.
Moisture at 100° C.,	8.67
Ash,	5.70
Nitrogen,	5.72
Phosphoric acid,	1.57
Potassium oxide,	.97
Calcium oxide,	.71
Magnesium oxide,	.65
Insoluble matter,	1.21

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Cotton Waste.

[Sent on by Samuel Pillsbury, Boston, Mass.]

	Per cent.
Moisture at 100° C.,	8.24
Nitrogen,	2.09
Phosphoric acid,	.83
Calcium oxide,	2.52
Magnesium oxide,	.66
Potassium oxide,	1.62
Insoluble matter,	20.10

Wool Waste.

[Sent on by A. S. Shepard, Franklin, Mass.]

	Per cent.
Moisture at 100° C.,	7.67
Ash,	10 63
Phosphoric acid,	1.15
Potassium oxide,	.54
Nitrogen,	5.26
Insoluble matter,	5.83

Waste from Cotton-seed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	6.83
Ash,	23.47
Phosphoric acid,	.96
Potassium oxide,	.20
Nitrogen,	4.24
Insoluble matter,	17.74

Waste from Linseed Presses.

[Sent on by Oliver R. Robbins, Weston, Mass.]

	Per cent.
Moisture at 100° C.,	7.06
Ash,	2.34
Phosphoric acid,	2.43
Potassium oxide,	.24
Nitrogen,	8.05
Insoluble matter,	1.00

Scouring Liquor of Raw Wool.

[Sent on from Plymouth, Mass.]

	Per cent.
Moisture at 100° C.,	92.03
Dry matter,	7.97
Nitrogen (in liquid),	.09
Ash,	3.28
Calcium oxide,	.04
Magnesium oxide,	Trace.
Potassium oxide,	1.09
Sodium oxide,	.92
Iron and alumina oxides,	.09
Insoluble matter,	.22

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One hundred parts of ash contained, —

	Per cent.
Calcium oxide,	1.22
Magnesium oxide,	Trace.
Potassium oxide,	33.23
Sodium oxide,	28.05
Iron and alumina oxides,	2.74
Insoluble matter,	6.91

The above-stated liquid was obtained, according to information received, by scouring raw wool with a solution of soda-ash and soap. The most noticeable constituent of the material is its comparatively large amount of potash (1.09 per cent.) in the calcined residue or ash. The presence of a liberal amount of potash compounds in raw wool is well known. A sample of raw wool from South America, tested here in that direction some years ago, showed from 3.92 to 4.2 per cent. of potassium oxide. The washings of sheep and of raw wool may be used with a good effect on grass lands. Solutions like the one above described are, however, too concentrated for direct use; they ought to be diluted with from ten to twenty times their weight of water, to render advisable their direct application on any growing vegetation.

Refuse Material from Soap Works.

[Sent on by Holyoke Soap Works, Holyoke, Mass.]

	Per cent.
Moisture at 100° C.,	19.70
Total phosphoric acid,	15.37
Soluble phosphoric acid,	.03
Reverted phosphoric acid,	5.29
Insoluble phosphoric acid,	10.05
Nitrogen,	4.24
Insoluble matter,	1.37

This material is similar to tankage in composition and in mechanical condition.

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Fish Fertilizers.

[Sent on from Eastham, Mass. I. Salt Fish Waste. II. Fish Chum. III. Salt Fish Trimmings. IV. Whalebone. V. Whale Scrap.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	37.35	53.86	5.22	6.81	9.51
Total phosphoric acid,	2.89	3.80	5.50	20.84	1.15
Soluble phosphoric acid (8 cts. per lb.),	.58	.36	.69	.34	.84
Reverted phosphoric acid (7½ cts. per lb.),	1.16	1.77	2.15	1.84	.07
Insoluble phosphoric acid (3 cts. per lb.),	1.15	1.67	2 66	18.69	.24
Nitrogen (12 cts. per lb.),	5.26	4.26	7.63	3.40	9.64
Insoluble matter,	.10	.06	.26	3.69	9.10
Valuation per 2,000 lbs.,	$15.96	$14.46	$24.24	$22.67	$24 73

The main quantity of these substances was in a very coarse state.

Dry Ground Fish.

[I. and II. Sent on by R. P. Smith, Hatfield, Mass. III. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.34	9.92	10.10
Ash,	37.76	28.37	21.50
Total phosphoric acid,	8.23	7.96	6.67
Soluble phosphoric acid,	.10	.61	.32
Reverted phosphoric acid,	3.81	3.79	.75
Insoluble phosphoric acid,	4.32	3.56	5.60
Nitrogen,	6.81	6.82	6.98
Insoluble matter,	82	1.34	4.57

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Peruvian Guano.

[From P. Williams & Co., Taunton, Mass. I. Warranted Peruvian Guano, No. 1. II. Low-grade Peruvian Guano.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.18	16.14
Ash,	47.36	65.01
Total phosphoric acid,	19.91	22.26
Soluble phosphoric acid,	7.34	2.24
Reverted phosphoric acid,	6.05	5.03
Insoluble phosphoric acid,	6.52	14.99
Potassium oxide,	2.80	4.17
Nitrogen,	8.01	4.06
Insoluble matter,	4.04	7.83

Phosphatic Fertilizers.

[Sent on from Ashby, Mass. I. Acid Phosphate. II. Dissolved Bone-black. III. South Carolina Rock Phosphate.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	13.93	13.86	1.68
Total phosphoric acid,	13.84	16.37	25.81
Soluble phosphoric acid (8 cts. per lb.),	10.91	14.60	.27
Reverted phosphoric acid (7½ cts. per lb.),	.69	1.53	.47
Insoluble phosphoric acid (2 cts. per lb.),	2.24	.24	25.07
Insoluble matter,	9.54	2.09	11.64
Valuation per 2,000 lbs.,	$19.38	$25 80	$11.16

Bone-black.

[Sent on by F. G. Arnold, Swansea, Mass.]

	Per cent.
Moisture at 100° C.,	5.04
Ash,	67.43
Phosphoric acid,	16.56
Insoluble matter,	.37

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Ground Bones.

[I., II. and III. Sent on from Amherst, Mass. IV. Sent on from Jamaica Plain, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	63.29	40.44	56.69	37.48
Fine medium, smaller than $\frac{1}{25}$ inch,	27.78	30.91	34.97	35.51
Medium, smaller than $\frac{1}{12}$ inch,	8.93	25.30	8.34	18.91
Coarser than $\frac{1}{12}$ inch,	–	3.35	–	8.10
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.12	11 24	6.31	6.92
Ash,	41.62	58.66	47.63	68.64
Total phosphoric acid,	24.13	20.85	19.72	22.59
Soluble phosphoric acid,	.17	4.87	1.16	.20
Reverted phosphoric acid,	9.12	1.20	9.34	6.65
Insoluble phosphoric acid,	14.75	14.78	9.22	15.74
Nitrogen,	3.60	2.85	6.84	4.82
Insoluble matter,	.55	.48	.71	3.23

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Ground Bones.

[I. Sent on from Amherst, Mass. II. Sent on by A. S. Belcher, North Easton, Mass. III. Sent on by Edmund Hersey, Hingham, Mass. IV. Sent on by W. W. Sanderson, South Deerfield, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch, . . .	22.59	18.53	34.79	59.00
Fine medium, smaller than $\frac{1}{25}$ inch, .	18.71	10.14	21.22	24.09
Medium, smaller than $\frac{1}{12}$ inch, . .	24.61	7.12	14.71	12.32
Coarser than $\frac{1}{12}$ inch, ...	34.09	64.21	29.28	4.59
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C., ...	3.97	12.43	6.75	9.96
Ash, ...	49.35	64.21	61.35	55.83
Total phosphoric acid, ...	19.49	25.67	24.71	18.41
Soluble phosphoric acid, ...	–	.13	.09	2.73
Reverted phosphoric acid, ...	3 80	6.20	8.10	9.94
Insoluble phosphoric acid, ...	15.69	19.34	16.52	5.74
Nitrogen, ...	4.04	2.68	3.14	3.12
Insoluble matter, ...	.78	.42	.42	5.79

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Phosphate Slag.

[I. German "Phosphate Slag," New York. II. "Phosphate Slag" sent on from England.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	5.08	.37
Ferric oxide and aluminum oxide,	15.98	8.55
Total phosphoric acid,	21.05	18.91
Calcium oxide,	53.97	49.22
Magnesium oxide,	3.83	Not determined.
Insoluble matter,	Not determined.	5.06

This material has been of late introduced into our markets in a fine-ground state as "phosphate meal," manufactured of the "Peine-Thomas Scoria." P. Weidinger, No. 76 Pine Street, New York City, who has advertised the sale of the above material for trial, makes the following statement: —

"We offer to the American fertilizer trade the article above stated, whose rapid and successful introduction into various countries, with constantly increasing demand, gives us a guarantee that its importance for agriculture will not be underrated. This is a very finely ground phosphate meal, obtained from the so-called 'Peine-Thomas Scoria,' through the dephosphorization of pig iron, after the patented method of Sidney Gilchrist Thomas. The dephosphorization of the iron takes place by melting the iron with lime in a current of air, a proceeding by which pig iron, rich in phosphorus, is converted into steel, free from phosphorus (ingot iron). In this manner the phosphorus of the pig iron is converted into phosphoric acid, which, uniting with the lime added, forms phosphate of lime. The melted mixture of phosphate of lime with excess of lime and combinations of the iron and manganese, obtained by this proceeding, is called 'Thomas Scoria.' It is brought into the market for the purposes of agriculture in a finely ground state."

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The phosphoric acid present is neither to any extent soluble in water nor in a solution of citrate of ammonia. The composition of the slag is peculiar, on account of an excess of caustic lime, which favors a breaking up into minute particles when exposed to air and moisture. The more finely ground when exposed to atmospheric influences, the more rapidly takes place a general disintegration. This behavior tends to diffuse the phosphoric acid, and favors absorption by the roots. No previous treatment by acids has been found necessary to secure satisfactory returns when used as a phosphoric acid source for plant growth. On account of the alkaline reaction of the "phosphate meal," no ammonia salts or organic nitrogen compounds are used as an admixture for the production of more complete fertilizers. In case nitrogen shall be applied, nitrate of soda is used, to furnish that element. Muriate of potash and kainite are recommended as potash sources.

European agricultural chemists speak well of this new source of phosphoric acid. As it is claimed that phosphoric acid can be furnished at less cost and more efficiently in the form of "phosphate meal" than in any of our known mineral resources of insoluble phosphoric acid, it seems desirable that experiments should be instituted to test its merits.

Fifteen dollars per 2,000 pounds has been asked in our vicinity for a finely ground material.

Concentrated Flower Food.

[Sent on from Springfield, Mass.]

	Per cent.
Moisture at 100° C.,	11.20
Ash,	42.89
Phosphoric acid,	5.30
Sulphuric acid,	15.73
Potassium oxide,	4.72
Sodium oxide,	17.45
Calcium oxide,	6.18
Nitrogen in organic matter,	2.31
Nitrogen in nitrates,	4.66
Insoluble matter,	.25

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Compound Fertilizers.

[I. Sent on by A. S. Hawley, North Hadley, Mass. II. Sent on by Staples & Phillips, Taunton, Mass. III. Sent on by C. M. Allen, Franklin, Mass. IV. Sent on by F. G. Arnold, Swansea, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.86	11.71	6.76	6.26
Ash,	48.44	57.84	52.96	56.88
Total phosphoric acid,	11.07	13.30	8.32	12 56
Soluble phosphoric acid,	5.87	5.80	2.86	2.09
Reverted phosphoric acid,	3.60	1.85	5.01	6.10
Insoluble phosphoric acid,	1.60	5.65	.45	4.37
Nitrogen in organic matter,	1.65	2.10	.19	3.78
Nitrogen in nitrate,	–		3.44	
Potassium oxide,	3.19	1.63	8.60	9.87
Insoluble matter,	5.50	6.01	1.52	3.03

Compound Fertilizers.

[I. Sent on by A. Bradley, Lee, Mass. II. Sent on by F. H. Bardwell, Hatfield, Mass. III. and IV. Sent on by Oscar L. Dorr, Sharon, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.43	12 34	10.50	19.47
Ash,	41.15	64.14	56.62	50.40
Total phosphoric acid,	8 90	12.33	12.86	8.32
Soluble phosphoric acid,	7.45	5.65	4.72	4.02
Reverted phosphoric acid,	1.06	3.22	5.25	2.02
Insoluble phosphoric acid,	.39	3.46	2.89	2.28
Potassium oxide,	7.28	1.34	5.00	2.54
Nitrogen,	4.73	1.52	3.80	3.28
Insoluble matter,	.94	6.56	1.61	10.19

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Compound Fertilizers.

[I. Sent on by J. M. Aiken, Prescott, Mass. II. Sent on by W. W. Sanderson, South Deerfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.47	6.26
Ash,	54.21	62.53
Total phosphoric acid,	13.61	9.88
Soluble phosphoric acid,	3.91	3.97
Reverted phosphoric acid,	6.24	3.09
Insoluble phosphoric acid,	3.46	2.82
Potassium oxide,	1.45	3.54
Nitrogen,	2.48	1.38
Insoluble matter,	7.44	7.38

Compound Fertilizers.

[I. Sent on by Lawrence Hardware Co., Lawrence, Mass. II. Sent on by J. M. Aiken, Prescott, Mass. III. Sent on by A. Bradley, Lee, Mass. IV. Sent on by J. M. Aiken, Prescott, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.36	10.66	17.07	13.34
Ash,	59.19	60.64	44.24	49.38
Total phosphoric acid,	16.44	12.50	9.28	13.02
Soluble phosphoric acid,	4.03	5.50	7.47	6.81
Reverted phosphoric acid,	8.46	1.29	1.43	2.56
Insoluble phosphoric acid,	3.95	5.71	.38	3.65
Potassium oxide,	1.15	2.50	7.64	2.16
Nitrogen,	2.65	1.70	1.34	3.02
Insoluble matter,	3.43	8.09	1.69	5.07

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VALUATION OF FERTILIZERS AND FERTILIZER ANALYSES.

The hitherto customary valuation of manurial substances is based on the average trade value of the fertilizing elements specified by analyses. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the cash retail price at which the several specified essential elements of plant food, in an efficient form, have been offered of late for sale in our large markets.

The market value of low-priced materials used for manurial purposes, such as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different descriptions, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The market price of manurial substances is liable to serious fluctuations; for supply and demand exert here, as well as in other branches of commercial industry, a controlling influence on their temporary money value. As farmers in many instances have but little chance to obtain the desired information, agricultural chemists charged with the inspection of commercial fertilizers assist in the work, by ascertaining as far as practicable the actual market price of the leading

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manurial substances in our principal markets for a given period of time. The results of the inquiries into the condition of the trade during the six months preceding the 1st of March, 1888, are embodied in the subsequent tabular statement of cost of fertilizing ingredients for the opening of the season of 1888.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultation with leading manufacturers of fertilizers, and notes on actual sales of individual farmers and farmers' associations, etc., furnish the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1, 1888, and increasing them by twenty per cent., to cover expenses of sales, credits, etc.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1888. Cents per Pound.
Nitrogen in ammoniates,	17½
Nitrogen in nitrates,	16
Organic nitrogen in dry and fine-ground fish, meat, blood, cotton-seed meal and castor pomace,	16½
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn-shavings and coarse fish scrap,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,*	7½
Phosphoric acid in dry-ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarser bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in forms free from muriate and chlorides,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

* Dissolved from two grams of phosphate unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09 in thirty minutes at 65° C., with agitation once in five minutes; commonly called "reverted" or "back-gone" phosphoric acid.

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The above trade values are the figures at which, in the six months preceding March 1, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the reasonable retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dried ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substances. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers and refuse materials of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

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A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of these substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practical, on guaranty of composition with reference to their essential constituents, and see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

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Analyses of Water sent on for Examination.

[Parts per Million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
I., . . .	.108	.160	17.80	148.00	60.00	4.03	–	No. Amherst.
II., . . .	.01	.06	7.00	104.00	56.00	4.57	None.	Amherst.
III., . . .	.23	.34	47.00	312.00	206.00	9.14	None.	Amherst.
IV., . . .	.25	.44	19.00	202.00	68.00	2.86	Present.	Littleton.
V., . . .	.09	.10	6.00	132 00	72.00	3.25	None.	No. Amherst.
VI., . . .	.40	.12	137.20	546.00	124.00	–	–	Amherst.
VII., . .	.03	.05	6.00	64.00	46.00	1.56	None.	Ipswich.
VIII., .	SO_3 — 82.00 CaO — 63.00		64.00	310.00	100.00	9.57	–	Ashby.
IX., . . .	.12	.09	None	38.00	30.00	.63	–	Ashby.
X., . . .	.08	.08	42.00	300.00	76.00	7.60	–	Ashby.
XI., . . .	.17	.05	20 00	192.00	104.00	3.12	None.	No. Amherst.
XII., . .	.07	.02	9.00	138.00	60.00	2.86	None.	Ashby.
XIII., . .	None	.02	20.00	178.00	70.00	1.82	None.	Ashby.
XIV., . .	.44	.28	22.00	160.00	40.00	3.12	None.	Ashby.
XV., . .	.05	.18	144.00	530.00	102.00	5.43	None.	Ashby.
XVI., . .	.13	.46	None	70.00	36.00	1.43	–	Amherst.
XVII., . .	.08	.08	42.00	334.00	108.00	5.29	None.	Amherst.
XVIII., . .	.12	.28	6.00	86.00	26.00	1.43	None.	East Amherst.
XIX., . .	.05	.44	20.00	146.00	52.00	4.57	None.	East Amherst.
XX., . .	None	.04	9.00	72.00	24.00	1.27	None.	East Amherst.
XXI., . .	.26	.24	20.00	124.00	46.00	1.11	None.	Boston.
XXII., . .	.10	.10	9.10	72.00	52.00	1.11	None.	Boston.
XXIII., . .	.64	.36	45 00	268.00	96.00	8.43	–	Sherborn.
XXIV., . .	None	.06	12.00	106.00	56.00	2.21	None.	Wellesley.
XXV., . .	None	.09	25.04	318.00	76.00	7.86	Present.	No. Hadley.
XXVI., . .	–	–	–	–	–	–	None.	No. Hadley.
XXVII., . .	.066	.14	18.00	208.00	96.00	5.00	–	No. Amherst.
XXVIII., .	3.33	.80	127.00	720.00	224.00	10.00	None.	No. Hadley.
XXIX., . .	Trace	.06	Trace	38.00	30.00	1.69	None.	No. Hadley.
XXX., . .	None	.06	31.00	196.00	76.00	3.51	None.	Shirley.
XXXI., . .	1.30	.40	47.40	7.14	380.00	98.00	None.	Shirley.
XXXII., . .	.03	.06	8.00	98.00	22.00	2.60	None.	No. Amherst.
XXXIII., .	4.70	1.50	125.00	844.00	182.00	10.10	–	No. Hadley.
XXXIV., .	.12	.20	None	40.00	24.00	–	–	Amherst.
XXXV., . .	.09	.09	Trace	68.00	28.00	–	–	Amherst.
XXXVI., .	.12	.05	3.00	68.00	26.00	2.21	None.	Amherst.

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ANALYSES OF WATER — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degrees).	Lead.	LOCALITY.
XXXVII., .	.02	.04	None	38.00	22.00	–	–	Worthington.
XXXVIII., .	.01	.05	None	52.00	30.00	.79	–	Worthington.
XXXIX., .	Trace	.02	None	22.00	14.00	1.43	–	Worthington.
XL., . .	1.15	.05	28.00	306.00	82.00	7.86	–	Amherst.
XLI., . .	.02	.14	None	24.00	12.00	–	–	Worthington.
XLII., . .	Trace	.02	Trace	54.00	40.00	.95	–	Worthington.
XLIII., . .	.04	.03	None	52.00	36.00	2.08	–	Worthington.
XLIV., . .	–	–	–	–	–	–	Present.	East Amherst.
XLV., . .	–	–	–	–	–	–	None.	East Amherst.
XLVI., . .	–	–	–	–	–	–	None.	Amherst.
XLVII., . .	–	–	–	–	–	–	None.	Berlin.
XLVIII., .	Trace	.05	None	22.00	2.00	–	–	Worthington.
XLIX., . .	.12	.12	None	148.00	64.00	1.56	None.	No. Hadley.
L., . . .	.14	.58	.60	74.00	34.00	3.12	None.	Westhampton.
LI., . . .	.05	.20	5.00	86.00	54.00	2.34	None.	Wellesley.
LII., . .	.10	.14	Trace	238.00	114.00	7.00	–	So. Hadley.
LIII., . .	.01	.10	23.00	154.00	50.00	2.86	–	Ashby.
LIV., . .	1.40	7.90	4.00	422.00	322.00	17.06	None.	Amherst.
LV., . . .	1.50	.70	126.00	482.00	198.00	8.29	None.	Amherst.
LVI., . .	.40	.55	8.00	142.00	58.00	3.90	None.	Amherst.
LVII., . .	.01	.016	2.00	148.00	64.00	4.71	Present.	Amherst.
LVIII., . .	.02	.05	18.00	148 00	40.00	4.86	None.	Amherst.
LIX., . .	.04	.05	11.00	52.00	16.00	1.95	None.	Amherst.
LX., . .	.05	.05	9.00	20.00	8.00	1.56	None.	Amherst.
LXI., . .	.03	.04	13.00	116.00	60 00	2.86	None.	Amherst.
LXII., . .	.01	.07	34.00	292.00	156.00	5.86	None.	Amherst.
LXIII., . .	.03	.10	6.00	216.00	44.00	5.00	None.	Amherst.
LXIV., . .	.03	.16	Trace	88.00	48 00	.32	None.	Amherst.
LXV., . .	1.36	1.20	57.00	412.00	108.00	8.14	–	Amherst.
LXVI., . .	.003	.04	24.00	120.00	56.00	6.29	–	Amherst.
LXVII., . .	.016	.044	3.00	140.00	70.00	.63	None.	No. Dana.
LXVIII., .	.45	.35	8.00	52.00	20.00	1.56	None.	No. Amherst.
LXIX., . .	.06	.10	22.00	116.00	26 00	2.21	None.	Amherst.
LXX., . .	.026	.08	38.00	324.00	160.00	8.29	None.	Amherst.
LXXI., . .	.024	.044	22.00	308.00	64 00	5.14	None.	Amherst.
LXXII., . .	.124	.148	2.00	56.00	12.00	1 11	None.	Amherst.
LXXIII., .	–	.05	Trace	45.00	35.00	1.56	None.	Littleton.

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ANALYSES OF WATER — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clark's degree).	Lead.	LOCALITY.
LXXIV., .	.06	.05	53.00	325.00	177.00	7.43	None.	Northampton.
LXXV., . .	Trace	.04	25.00	212.00	112.00	4.86	-	Amherst.
LXXVI., .	.04	.06	19.00	92.00	40.00	.95	-	Amherst.
LXXVII., .	.07	.05	Trace	62.00	42.00	.79	None.	Amherst.
LXXVIII., .	.04	.22	Trace	34.00	4.00	-	-	Amherst.
LXXIX., .	.01	.04	3.00	68.00	22.00	1.56	None.	Amherst.
LXXX., . .	.02	.07	5.00	40.00	10.00	1.11	None.	Amherst.
LXXXI., .	.03	.08	12.00	112.00	51.00	2.99	None.	Framingham.
LXXXII., .	Trace	.18	13.00	153.00	94.00	3.25	None.	Amherst.
LXXXIII., .	.03	.10	Trace	70.00	45.00	1.11	None.	Sunderland.
LXXXIV., .	.04	.08	Trace	45.00	30.00	-	None.	Northampton.
LXXXV., .	.04	.07	15.00	111.00	70.00	3 79	None.	Northampton.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indications of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundreths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

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5. Albuminoid ammonia over .15 parts per million ought to absolutely condemn the water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the above results of analyses shows that Nos. 5, 9, 10, 11, 17, 22, 27, 35, 36, 64, 78 and 82 are of a suspicious character, and that Nos. 1, 3, 4, 6, 14, 15, 16, 18, 19, 21, 23, 28, 31, 33, 34, 40, 49, 50, 51, 52, 54, 55, 56, 64, 65, 68 and 72 ought to be condemned, on account of a large amount of free and albuminoid ammonia, due most likely to access of sewage water. An examination of the above statement shows that a large proportion of the samples received were from bad wells. Of fifty-eight samples of water tested for lead, four were found to be poisoned by that metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live stock, and on the personal attention bestowed, from time to time, on the condition of the well and its surroundings. Good wells are liable to change for the worst at any time, on account of circumstances too numerous to state in this connection. To ascertain, from time to time, the exact condition of the water which supplies the wants of the family and of the live stock, is a task which no farmer can, for any length of time, neglect, without incurring a serious risk to health and prosperity.

The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities which an apparently good water may contain are disguised beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopic observations, are, in the majority of cases, the only reliable means, in our present state of scientific inquiry, by which desirable information regarding the true character of a drinking water can be obtained.

Parties sending on water for an analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

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Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.*

Prepared by Mr. W. H. Beal.

As the basis of valuation changes from year to year, no valuation is stated.

1868 to 1889

Muriate of Potash (45 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.05	.05	2.05
Potassium oxide,	58.98	45.94	52.46
Sodium oxide,	11.26	2.13	6.69
Magnesium oxide,	.90	.30	.55
Chlorine,	54.00	43.20	48.60
Insoluble matter,	2.00	.15	.75

Sulphate of Potash (15 Analyses).

Moisture at 100° C.,	5.00	.19	1.00
Potassium oxide,	51.28	20.44	35.86
Sodium oxide,	8.59	.34	4.46
Magnesium oxide,	2.63	.24	1.50
Sulphuric acid,	59.30	10.86	45.00
Insoluble matter,	31.55	.14	.75

* This compilation does not include the analyses made of licensed fertilizers. They are to be found in the Reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the Reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

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Sulphate of Potash and Magnesia (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.58	1.95	5.50
Potassium oxide,	27.77	11.70	22.50
Sodium oxide,	18.97	2.09	6.50
Magnesium oxide,	13.66	10.86	12.25
Calcium oxide,	3.38	.82	2.50
Sulphuric acid,	47.90	31.91	43.00
Chlorine,	7.80	.14	2.50
Insoluble matter,	2.36	.26	1.41

German Potash Salts (11 Analyses).

Moisture at 100° C.,	25.83	.45	13.14
Potassium oxide,	50.40	7.56	21.63
Sodium oxide,	26.23	1.30	13.76
Calcium oxide,	1.26	.06	.85
Magnesium oxide,	9.83	Trace.	9.25
Sulphuric acid,	21.53	.17	10.85
Chlorine,	49.11	22.27	35.63
Insoluble matter,	3.76	.90	2.08

Kainite (3 Analyses).

Moisture at 100° C.,	13.57	2.15	9.26
Potassium oxide,	16.48	12.51	14.04
Sodium oxide,	–	–	21.38
Calcium oxide,	1.41	.82	1.12
Magnesium oxide,	11.30	6.65	8.97
Sulphuric acid,	23.71	17.53	21.05
Chlorine,	–	–	32.38
Insoluble matter,	1.56	.17	.86

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Carnallite (1 Analysis).

	Per cent.
Potassium oxide,	13.68
Sodium oxide,	7.66
Magnesium oxide,	13.19
Sulphuric acid,	.56
Chlorine,	41.56

Krugite (1 Analysis).

	Per cent.
Moisture at 100° C.,	4.82
Calcium oxide,	12.45
Magnesium oxide,	8.79
Potassium oxide,	8.42
Sodium oxide,	5.57
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter,	14.96

Sulphate of Magnesia (9 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	31.90	7.50	22.50
Calcium oxide,	3.89	1.15	2.52
Magnesium oxide,	25.29*	13.50	18.25
Sulphuric acid,	52.23*	31.91	37.00
Insoluble matter,	11.06	.40	5.73

* Kieserite, natural and calcined.

Nova Scotia Plaster (9 Analyses).

Moisture at 100° C.,	15.79	.52	6.50
Calcium oxide,	37.59	30.60	33.50
Magnesium oxide,	1.40	.36	.75
Sulphuric acid,	54.10	33.56	44.00
Insoluble matter,	7.95	.45	2.00

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Onondaga Plaster * (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.25	8.95	13.27
Calcium oxide,	31.46	29.15	30.00
Magnesium oxide,	6.06	3.89	4.66
Sulphuric acid,	36.00	31.58	33.00
Carbonic acid,	8.80	7.20	8.20
Insoluble matter,	12.00	8.28	9.83

* Contains 1 sample of Cayuga plaster.

Gypseous Shale (1 Analysis).

	Per cent.
Calcium sulphate,	38.55
Calcium carbonate,	11.05
Magnesium carbonate,	2.65
Insoluble matter,	37.15

Gas-house Lime (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	33.55	11.01	22.28
Calcium oxide,	45.80	40.00	42.66
Magnesium oxide,	8.30	8.30	8.30
Sulphuric acid,*	20.73	20.73	20.73
Insoluble matter,	15.00	.40	6.05

* Sulphuric acid includes all forms of sulphur present.

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Lime Waste.

	Per Cent.		
	Liquid from Lime-vats (evaporated).	Mass from bottom of Lime-vats.	Lime waste from Sugar Factory.
Moisture at 100° C.,	11.50	17.54	36.30
Ash,	41.00	65.24	–
Calcium oxide,	23.40	47.80	27.51
Magnesium oxide,	–	–	Trace.
Potassium oxide,	–	–	.22
Phosphoric acid,	.77	.81	2.25
Nitrogen,	6.87	1.06	–
Insoluble matter,	.10	5.50	.32

Lime-kiln Ashes (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	30.70	.20	15.45
Calcium oxide,	50.16	36.00	43.08
Magnesium oxide,	4.45	1.26	2.60
Potassium oxide,	1.70	.02	.86
Phosphoric acid,	3.16	Trace.	1.18
Carbonic acid,	39.36	9.66	16.66
Insoluble matter,	53.77	3.30	14.54

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Marls * (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	55.80	.60	18.18
Calcium oxide,	50.61	20.72	40.07
Magnesium oxide,	1.03	.22	.64
Iron and alumina,	1.00	.36	.69
Phosphoric acid,	2.72	.07	1.05
Carbonic acid,	40.38	16.63	28.51
Insoluble matter,	3.44	3.44	3.44

* Massachusetts.

Virginia Marl.

	Per Cent.	
	2 feet below Surface.*	4 feet below Surface.†
Moisture at 100° C.,	16.70	15.26
Calcium oxide,	9.21	5.29
Magnesium oxide,	.25	.16
Potassium oxide,	.61	.37
Phosphoric acid,	.09	.08
Sulphuric acid,	1.00	.31
Carbonic acid,	4.23	1.76
Insoluble matter,	59.59	68.86

* No. 1 contained a large amount of shells. † No. 2 was largely sand.

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Wood Ashes. (Canada.) (87 Analyses.)

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	28.57	.70	12.00
Calcium oxide,	50.89	18.00	34.44
Magnesium oxide,	7.47	2.28	3.50
Iron oxide,	–	–	.83
Potassium oxide,	10.24	2.49	5.50
Phosphoric acid,	3.99	.29	1.85
Insoluble matter,	24.10	2.10	12.50

Cotton-seed Hull Ashes (23 Analyses).

Moisture at 100° C.,	26.81	2.30	7.33
Calcium oxide,	39.75	3.35	10.00
Magnesium oxide,	17.15	2.02	9.50
Iron oxide,	–	–	1.50
Potassium oxide,	42.12	5.00	20.95
Phosphoric acid,	13.67	.76	7.52
Insoluble matter,	32.48	5.38	11.79

Ashes of Spent Tan-bark (3 Analyses).

Moisture at 100° C.,	7.45	4.87	6.31
Calcium oxide,	37.26	31.35	33.46
Magnesium oxide,	5.10	2.57	3.55
Potassium oxide,	2.87	1.14	2.04
Phosphoric acid,	2.77	.13	1.61
Insoluble matter,	24.33	24.33	24.33

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Ashes of Waste Products.

	Per Cent.		
	Chestnut R. R. Ties.	Logwood.	Mill.
Moisture at 100° C.,	6.15	1.50	.53
Calcium oxide,	4.71	3.90	34.93
Magnesium oxide,	1.80	Trace.	1.35
Potassium oxide,	.19	.08	1.60
Phosphoric acid,	1.54	2.30	.46
Insoluble matter,	77.83	9.70	36.36

Hard Pine Wood Ashes.

	Per cent.
Moisture at 100° C.,	.75
Calcium oxide,	24.95
Magnesium oxide,	8.39
Potassium oxide,	10.16
Phosphoric acid,	2.24
Insoluble matter,	29.90

Nitrate of Potash (2 Analyses).

	Per cent.	
Moisture at 100° C.,	1.75	2.10
Potassium oxide,	44.76	45.62
Nitrogen,	11.60	14.58
Insoluble matter,	Trace.	

Nitrate of Soda (13 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	2.00	.85	1.25
Sodium oxide,	70.97	35.00	35.50
Calcium oxide,	.41	Trace.	Trace.
Magnesium oxide,	.04	Trace.	Trace.
Nitrogen,	16.26	14.44	15.75
Sulphuric acid,	.20	Trace.	Trace.
Chlorine,	2.52	.20	.50
Insoluble matter,	.90	.24	.50

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Saltpetre Waste from Gunpowder Works (7 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	4.24	.50	2.75
Potassium oxide,	30.94	4.65	18.00
Sodium oxide,	45.92	22.08	34.00
Calcium oxide,	.83*	.71*	.75
Magnesium oxide,	.28*	.09*	.19
Nitrogen,	3.30	.80	2.43
Sulphuric acid,	4.85*	.84*	2.85
Chlorine,	56.00	37.66	48.30

* Only estimations reported.

Nitre Salt-cake (2 Analyses).

Moisture at 100° C.,	6.71	5.34	6.03
Potassium oxide,	.87	Trace.	.87
Sodium oxide,	32.72	26.40	29.56
Nitrogen,	2.29	–	2.29
Sulphuric acid,	48.85	46.69	47.77
Insoluble matter,	4.12	3.73	3.92

Sulphate of Ammonia (22 Analyses).

Moisture at 100° C.,	2.40	.13	1.00
Nitrogen,	22.23	19 70	20.50
Sulphuric acid,	70.70	57.68	60.00
Insoluble matter,	–	–	Trace.

Ammonite.

	Per cent.
Moisture at 100° C.,	5.88
Phosphoric acid,	3.43
Nitrogen,	11.33
Insoluble matter,	1.38

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Dried Blood (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	21.52	7.65	12.50
Ash,	10.04	3.56	6 37
Phosphoric acid,	6.23	1.53	1.91
Nitrogen,	13.55	7.80	10.52

Refuse Materials (Animal).

	Per Cent.		
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.
Moisture at 100° C.,	8.54	39.24	7.25
Ash,	14.42	33.53	–
Calcium oxide,	–	–	3.94
Magnesium oxide,	–	–	1.27
Phosphoric acid,	.88	–	3.19
Nitrogen,	12.12	5.26	2.43
Insoluble matter,	.96	8.44	39.05

Horn and Hoof Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.27	10.08	10.17
Ash,	14.62	1.05	7.63
Phosphoric acid,	–	–	2.30
Nitrogen,	16.10	11.84	14.47
Insoluble matter,	–	–	.24

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Wool Waste (3 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.12	8.43	9.27
Nitrogen,	6.25*	5.00	5.62

* Saturated with oil.

Raw Wool and Wool Washings.

	Per Cent.			
	Raw Wool.	Water Washings.	Acid Washings.	Liquid from Wool Washings.
Moisture at 100° C.,	6.95	–	–	92.03
Ash,	7.54	–	–	3.28
Fat,	3.92	–	–	–
Calcium oxide,	–	.28	.61	.04
Magnesium oxide,	–	None.	.20	Trace.
Potassium oxide,	–	3.92	4.20	1.09
Sodium oxide,	–	.49	.40	.92
Nitrogen,	12.88	–	–	.09
Insoluble matter,	3.63	–	–	.22

Meat Mass (6 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	18.75	8.16	12.09
Ash,	14.66	2.90	13.60
Total phosphoric acid,	3.58	.56	2.07
Nitrogen,	11.50	9.69	10.44
Insoluble matter,	.77	.40	.58

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Refuse from Rendering Establishments.

	Per Cent.					
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap Grease Refuse.	
					I.	II.
Moisture at 100° C.,	82.92	14.80	10.80	92.14	38.79	19.70
Ash,	7.07	8.40	7.50	–	43.13	59.65
Phosphoric acid,	1.26	.53	.46	.14	11.04	15.37
Nitrogen,	1.14	9.97	14.47	1.12	2.21	4.20
Insoluble matter,	–	.64	.26	–	1.20	1.37

Bones (103 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	11.90	3.05	7.47
Ash,	74.90	37.25	56.07
Total phosphoric acid,	29.83	12.06	22.50
Soluble phosphoric acid,	.76	.10	.43
Reverted phosphoric acid,	16.78	2.24	6.50
Insoluble phosphoric acid,	23.37	8.13	15.70
Nitrogen,	6.75	1.50	4.12
Insoluble matter,	6.00	.04	2.00

Tankage (12 Analyses).

Moisture at 100° C.,	28.09	5.46	14.61
Ash,	37.06	19.40	23.23
Total phosphoric acid,	14.60	8.00	10.67
Soluble phosphoric acid,	.27	.27	.27
Reverted phosphoric acid,	–	–	3.25
Insoluble phosphoric acid,	–	–	8.79
Nitrogen,	8.07	5.82	7.08
Insoluble matter,	2.00	.56	1.23

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Fish containing 20 per cent. or less of Moisture (47 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	19.88	6.61	13.24
Ash,	72.23	15.99	20.00
Total phosphoric acid,	16.64	4.33	8.25
Soluble phosphoric acid,	1.70	.37	.55
Reverted phosphoric acid,	4.57	1.78	2.17
Insoluble phosphoric acid,	7.16	2.11	3.80
Potassium oxide,	.45	.45	.45
Nitrogen,	10.24	3.87	7.05
Insoluble matter,	4.99	.74	2.50

Fish containing between 20 per cent. and 40 per cent. of Moisture (8 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	38.11	20.58	29.34
Ash,	36.50	16.87	24.14
Total phosphoric acid,	8.90	5.60	7.25
Soluble phosphoric acid,	–	–	.82*
Reverted phosphoric acid,	–	–	2.87*
Insoluble phosphoric acid,	–	–	3.99*
Potassium oxide,	–	–	.85†
Nitrogen,	7.41	4.22	5.81
Insoluble matter,	2.89	.82	1.85

* Fish pomace. † Dry ground fish.

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Fish containing 40 per cent. and more of Moisture (12 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	50.58	40.35	45.46
Ash,	20.78	1.92*	12.50
Total phosphoric acid,	8.56	1.02*	5.08
Soluble phosphoric acid,	1.51	.83	1.17
Reverted phosphoric acid,	2.02	.64	1.33
Insoluble phosphoric acid,	3.62	1.88	2.75
Nitrogen,	7.60	2.43	4.97
Insoluble matter,	2.44	.16	1.35

* Fish-liver refuse.

Whale Flesh.

	Per Cent.			
	Raw.	Dry (with Fat).	Dry (without Fat).	Whale Scrap.
Moisture at 100° C.,	44.50	–	–	9.51
Ash,	1.04	1.86	3.20	11.74
Fat,	22.81	40.70	–	–
Flesh,	32.10	57.44	96.80	–
Nitrogen,	4.86	8.68	14.60	9.64

Lobster Shells.

	Per cent.
Moisture at 100° C.,	7.27
Calcium oxide,	22.24
Magnesium oxide,	1.30
Phosphoric acid,	3.52
Nitrogen,	4.50
Insoluble matter,	.27

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Peruvian Guano (26 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	22.61	7.02	14.81
Ash,	61.65	13.58	37.61
Total phosphoric acid,	23.10	3.43	13.26
Soluble phosphoric acid,	8.80	.35	4.57
Reverted phosphoric acid,	6.20	1.38	3.79
Insoluble phosphoric acid,	16.50	4.67	10.58
Potassium oxide,	4.08	1.14	2.61
Nitrogen,	11.26	4.44	7.85
Insoluble matter,	11.91	1.30	6.60

Bat Guano (9 Analyses).

[One sample contained 1.31 per cent. potassium oxide.]

Moisture at 100° C.,	72.38	7.80	40.09
Ash,	72.14	4.34	38.24
Phosphoric acid,	6.53	1.00	3 76
Nitrogen as nitrates,	1.80	.24	1.02
Nitrogen as ammoniates,	3.42	1.49	2.45
Nitrogen in organic matter,	5.66	.34	3.00
Insoluble matter,	54.15	.20	2.00

Cuba Guano (7 Analyses).

Moisture at 100° C.,	36.85	12.10	24.27
Potassium oxide,	1.20	.14	.67
Phosphoric acid,	24.35	11.54	17.94
Nitrogen as nitrates,	1.00	.24	.62
Nitrogen as ammoniates,	.26	.14	.20
Nitrogen in organic matter,	1.48	.23	.85
Insoluble matter,	3.40	2.95	3.17

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Caribbean Guano (*Orchilla*) (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.50	2.12	7.31
Calcium oxide,	45.00	34.91	39.95
Magnesium oxide,	4.13	2.46	3 29
Phosphoric acid,	35.43	18.11	26.77
Sulphuric acid,	2.36	1.80	2.08
Insoluble matter,	2.40	.17	1.27

South American Bone Ash.

	Per cent.
Moisture at 100° C.,	7.00
Calcium oxide,	44.89
Phosphoric acid,	35.89
Insoluble matter,	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	1.90	.10	1.50
Calcium oxide,	–	–	41.87*
Magnesium oxide,	–	–	3.03*
Iron and alumina oxide,	–	–	4.26*
Total phosphoric acid,	30.51	25.81	28.03
Soluble phosphoric acid,	–	–	.27*
Reverted phosphoric acid,	.47	.19	.33
Insoluble phosphoric acid,	30.31	25.07	27.69
Insoluble matter,	13.74	9.18	11.61

* Only estimate.

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Navassa Phosphate (2 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	–	–	5.60*
Calcium oxide,	37.67	37.22	37.44
Iron oxide,	11.79	8.75	10.27
Alumina oxide,	–	–	4.24*
Phosphoric acid,	34.45	34.09	34.27
Insoluble matter,	–	–	2 70*

* Only one test.

Brockville Phosphate (1 Analysis).

	Per cent.
Moisture at 100° C.,	2 50
Phosphoric acid,	35.21
Insoluble matter,	6.46

Bone-black (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	10.65	1.55	4.60
Phosphoric acid,	30.54	23.47	28.28
Insoluble matter,	6.60	1.53	3.64

Phosphatic Slags.

[I. German phosphatic slag. II. English slag.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.10	.37
Calcium oxide,	41.87	49.82
Magnesium oxide,	3.03	–
Iron and alumina oxides,	4.26	–
Total phosphoric acid,	30.51	18.91
Soluble phosphoric acid,	–	–
Reverted phosphoric acid,	.19	5.93
Insoluble phosphoric acid,	30.32	12.98
Insoluble matter,	13.74	5.06

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Castor Bean Pomace (4 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100 C.,	10.18	9.25	9.98
Calcium oxide,	.96	.77	.87
Magnesium oxide,	.37	.20	.29
Potassium oxide,	1.70	.64	1.12
Phosphoric acid,	2.22	2.03	2.16
Nitrogen,	5.72	5.33	5.56
Insoluble matter,	2.38	1.12	1.75

Cotton Refuse.

	Per Cent.			
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	Cotton Waste.
Moisture at 100° C.,	34.46	5.53	34.69	8.24
Ash,	50.93	–	–	–
Calcium oxide,	.90	1.45	2.45	2.52
Magnesium oxide,	.90	.87	1.13	.66
Potassium oxide,	.19	.89	.80	1.62
Phosphoric acid,	.21	.84	1.54	.83
Nitrogen,	.50	1.32	1.30	2.09
Insoluble matter,	47.46	49.68	41.33	20.10

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Cotton-seed Meal (6 Analyses).

[I. Average of five analyses. II. Damaged.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.80	9.90
Ash,	5.77	–
Calcium oxide,	.39	.22
Magnesium oxide,	.99	.56
Potassium oxide,	.89	1.21
Phosphoric acid,	1.45	1.26
Nitrogen,	6.10	3.73
Insoluble matter,	.60	.20

Rotten Brewer's Grain.

	Per cent.
Moisture at 100° C.,	78.77
Calcium oxide,	.26
Magnesium oxide,	.15
Potassium oxide,	.04
Phosphoric acid,	.43
Nitrogen,	.72
Insoluble matter,	.59

Tobacco Stems (5 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	12.18	8.95	10.61
Ash,	15.00	13.30	14.07
Calcium oxide,	4.76	3.39	3.89
Magnesium oxide,	1.40	1.11	1.23
Potassium oxide,	8.82	3.34	6.44
Sodium oxide,	.68	.16	.34
Phosphoric acid,	.87	.44	.60
Nitrogen,	2.69	.90	2.29
Insoluble matter,	1.35	.29	.82

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Refuse Materials (Vegetable).

	Per Cent.		
	Glucose Refuse.	Hop Refuse.	Sumac Waste.
Moisture at 100° C.,	8.10	8.98	63.06
Ash,	–	–	6.80
Calcium oxide,	.18	.27	1.14
Magnesium oxide,	.02	.10	3.25
Potassium oxide,	.15	.11	.17
Phosphoric acid,	.29	.20	–
Nitrogen,	2.62	.98	1.19
Insoluble matter,	.07	.63	2.25

Sea-weed.

	Per Cent.				
	Eel-Grass.		Rockweed.		Wet Kelp.
	I.	II.	Green.	Dry.	
Moisture at 100° C.,	45.61	25.17	68.50	10.68	88.04
Ash,	20.39	10.81	23.70	55.75	2.26
Calcium oxide,	1.56	2.70	–	7.66	–
Magnesium oxide,	.09	.12	–	.21	–
Potassium oxide,	1.61	.21	–	4.89	–
Sodium oxide,	2.51	.74	–	7.90	–
Phosphoric acid,	.41	.22	–	2.75	–
Nitrogen,	.70	.96	.62	1.45	.26
Insoluble matter,	.46	1.66	–	10.40	–

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Sea-weed Ashes.

	Per cent.
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	.92
Sodium oxide,	8.76
Phosphoric acid,	.30
Sulphuric acid,	2.98
Sulphur,	.14
Chlorine,	6.60
Magnesium chloride,	.14
Insoluble matter,	63.65

Rockweed.

[I. Collected in May. II. Collected in December.]

	Per Cent.	
	I.	II.
Fresh wet rockweed lost, in air, of water,	78.700	65.920
Fresh wet rockweed lost, at 100° C., of water,	90.400	76.920
Air-dried rockweed contained, of vegetable matter,	88.220	89.000
Air-dried rockweed contained, of water,	11.780	11.000
The filled pods left, at 100° C., of solid organic matter,	7.360	–
The fresh stems left, at 100° C., of solid organic matter,	30.650	–
The slime of the pods, dried at 100° C., contained, of nitrogen,	2.920	–
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	2.286	1.721
Rockweed, air-dried, contained, of nitrogen,	2.017	1.432
" fresh (wet), contained, of nitrogen,	.487	.397
" dried at 100° C., contained, ashes,	28.930	24.890
" air-dried, contained, ashes,	6.220	22.150
" fresh (wet), contained, ashes,	3.770	5.825
The slime of the pods contained, ashes,	49.356	–

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One hundred parts of the ash contained (I.): —

	Per cent.
Potassium oxide,	4 842
Sodium oxide,	12.050
Calcium oxide,	2.691
Magnesium oxide,	2.753
Ferric oxide,	.338
Sulphuric acid,	7.986
Phosphoric acid,	6.240

Mud.

	Per Cent.					
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.
Moisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37
Ash,	27.29	72.02	49.28	33.09	39.60	–
Calcium oxide,	.93	23.39	.90	.91	.91	1.27
Magnesium oxide,	.14	–	.31	.43	.66	.29
Potassium oxide,	6.17	–	.33	.32	.38	.22
Sodium oxide,	.70	–	.94	.94	.86	–
Ferric oxide,	3.48	8.26	4.55	3.70	4.26	1.80
Phosphoric acid,	.10	.35	Trace.	Trace.	Trace.	.26
Nitrogen,	.21	.72	.39	.40	1.64	1.37
Insoluble matter,	–	37.60	43.55	26.20	31 84	18.26

Soil from a Diked Marsh.

	Per cent.
Moisture at 100° C.,	33.40
Ash,	7.85
Calcium oxide,	1.24
Potassium oxide,	.26
Phosphoric acid,	.13
Nitrogen,	1.64
Insoluble matter,	3.65

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Muck (11 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	89.89	12.03	55.13
Ash,	26.12	3.05	13.75
Nitrogen,	1.82	.26	.95

Peat (10 Analyses).

	Per Cent.		
	Highest.	Lowest.	Average.
Moisture at 100° C.,	85.38	11.29*	61.50
Ash,	33.72	1.20	7.71
Calcium oxide,	–	–	.50
Nitrogen,	1.79	.41	.75
Insoluble matter,	–	–	.38

* German peat mass.

Turf (2 Analyses).

	Per Cent.	
	I.	II.
Moisture at 100° C.,	25.58	13.00
Ash,	3.28	9.43
Nitrogen,	1.91	1.97

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Hen Manure.

	Per Cent.	
	Dried.	Fresh.
Moisture at 100° C.,	8.35	45.73
Calcium oxide,	2.22	.97
Magnesium oxide,	.62	–
Potassium oxide,	9 94	.18
Phosphoric acid,	2.02	.47
Nitrogen in organic matter,	1.85	.79
Nitrogen as ammoniates,	.28	
Insoluble matter,	34.65	39.32

Poudrette.

	Per cent.
Moisture at 100° C.,	5.25
Ash,	35.45
Potassium oxide,	49
Phosphoric acid,	5.74
Nitrogen,	3.58
Insoluble matter,	4.65

Miscellaneous.

	Per Cent.	
	Soot.	Ashes from Blue Works.
Moisture at 100° C.,	5.54	12.74
Organic and volatile matter,	22.90	36.22
Magnesium oxide,	–	Trace.
Potassium oxide,	1.83	9.02
Cyanogen compounds,	–	Trace.
Insoluble matter,	35.34	12.30

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COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS AND SUGAR-PRODUCING PLANTS, ETC.,

MADE AT

AMHERST, MASS.

1868–1889.

Prepared by Mr. W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with reference to Fertilizing Ingredients.

C. Analyses of Fruits.

D. Analyses of Sugar-producing Plants.

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A.—*Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained—													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen—Free Extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	10	29.73	11.39	20.65	17.19	8.36	11.43	3.38	1.81	2.59	63.05	42.02	55.70	27.29	20.93	24.56	5.43	1:7.18
Fodder corn (ensilaged),	12	28.40	13.12	20.34	12.58	6.91	8.70	6.07	3.15	3.89	65.69	42.99	56.93	35.25	17.67	25.36	5.21	1:9.96
Whole ears (ensilaged),	1	-	-	49.73	-	-	6.63	-	-	7.84	-	-	75.68	-	-	8.50	1.35	-
Green oats,	2	28.82	21.39	25.11	7.10	7.05	7.08	2.44	2.02	2.23	50.69	50.38	50.54	33.12	32.83	32.97	7.19	1:13.14
Herds-grass (timothy),	2	35.00	34.26	34.63	8.33	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.28	33.23	32.50	32.87	5.33	1:10.84
Hungarian grass,	1	-	-	25.93	-	-	9.38	-	-	1.01	-	-	57.80	-	-	24.67	7.15	1:6.86
Vetch and oats { 9 parts oats, 1 part vetch }	2	24.04	13.89	18.97	10.76	10.59	10.68	2.74	2.29	2.52	43.75	40.10	41.98	35.81	34.20	35.01	9.88	1:7.04
Horse bean,	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1:2.71
Cow-pea,	1	-	-	19.55	-	-	17.93	-	-	2.62	-	-	46.13	-	-	25.88	7.44	1:11.71
White lupine,	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Serradella,	1	-	-	15.40	-	-	17.75	-	-	2.65	-	-	41.54	-	-	26.21	11.85	1:4.07
II. Hay and Dry Coarse Fodders.																		
Fodder corn,	3	93.85	91.17	92.62	8.63	6.17	7.21	2.06	1.11	1.53	55.68	53.86	54.96	33.75	29.05	31.40	4.88	1:11.85
Corn stover,	6	93.05	75.00	83.73	12.15	6.47	8.21	2.63	1.27	2.09	63.05	48.82	54.65	36.10	29.93	30.41	4.66	1:10.43
Oats (in blossom),	1	-	-	93.57	-	-	6.58	-	-	2.92	-	-	50.03	-	-	34.06	6.41	1:14.23

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Oats (seed in milk),	1	-	-	90.45	-	-	10.89	-	-	2.69	-	-	46.02	-	-	34.32	6.06	1:7.90
Oats (ripe),	1	-	-	91.30	-	-	6.05	-	-	2.61	-	-	48.92	-	-	36.31	6.11	1:15.03
Winter rye,	1	-	-	91.45	-	-	10.66	-	-	2.57	-	-	47.40	-	-	32.97	6.40	1:8.23
Barley (seed in milk),	1	-	-	89.75	-	-	10.26	-	-	2.76	-	-	52.91	-	-	29.12	4.95	1:9.59
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.63	35.91	29.80	33.54	5.49	1:7.78
English hay,	3	91.70	89.22	90.12	9.75	8.75	9.12	2.65	2.55	2.61	54.43	45.96	56.59	35.55	29.21	31.65	5.97	1:10.24
Rowen (field-cured),	2	91.16	80.29	85.73	14.70	13.20	13.95	4.96	3.05	4.01	43.79	41.92	42.86	29.46	29.43	29.45	9.75	1:6.12
Rowen, ensilaged (air-dry),	1	-	-	81.56	-	-	12.34	-	-	6.98	-	-	43.99	-	-	27.93	8.76	-
Herds-grass (timothy),	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.75	36.59	29.21	32.90	4.85	1:11.44
Red-top,	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.67	34.11	31.12	32.92	4.97	1:12.06
Orchard grass,	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue,	2	92.60	91.97	92.21	7.27	7.02	7.15	2.17	1.78	1.98	49.18	48.16	48.67	34.61	34.46	34.54	7.68	1:12.98
Barn-yard grass,	1	-	-	93.35	-	-	15.27	-	-	1.95	-	-	38.24	-	-	33.72	10.82	1:2.94
Hungarian grass,	1	-	-	92.55	-	-	9.45	-	-	2.22	-	-	50.64	-	-	31.96	5.73	1:6.22
White daisy,	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Lucerne (alfalfa),	3	91.67	84.00	89.09	16.34	11.12	13.47	2.50	1.54	2.03	51.62	45.29	48.74	28.54	25.42	27.27	8.49	1:4.30
Sand lucerne,	1	-	-	91.20	-	-	16.26	-	-	2.59	-	-	50.31	-	-	21.27	9.57	1:3.50
Alsike clover,	2	91.70	91.36	91.53	17.32	14.97	16.15	3.26	2.89	3.08	44.94	44.63	44.79	26.28	21.44	23.86	12.14	1:4.96
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.94	23.58	19.06	21.67	9.29	1:4.82
Serradella,	2	92.80	91.36	92.05	17.85	15.26	16.56	2.91	2.37	2.64	50.23	49.54	49.89	25.14	24.37	24.76	6.17	1:4.97
Vetch,	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.82	30.68	30.05	30.37	8.24	1:3.67
Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55

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A.—*Analyses of Fodder Articles*—Concluded.

NAME.	Analyses.	Dry Matter.			100 Parts of Dry Matter contained—													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen—Free Extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	4	14.51	13.05	13.92	12.17	7.82	10.47	1.76	.79	1.06	79.33	70.98	74.29	6.23	4.29	5.13	8.56	-
Beets, sugar,	6	19.53	14.01	16.48	17.44	7.32	11.63	.83	.39	.62	81.39	72.79	75.70	6.98	5.27	6.17	4.33	1:9.12
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.78	9.54	7.08	7.94	9.06	1:10.07
Ruta-bagas,	2	12.77	11.60	12.19	11.16	10.34	10.75	2.32	1.23	1.78	68.58	65.68	67.13	11.60	11.03	11.32	9.03	1:12.29
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	2	12.52	9.98	11.25	9.63	8.90	9.27	3.94	1.89	2.92	73.96	67.24	70.60	10.76	7.55	9.16	8.07	1:9.39
Potatoes,	9	21.95	13.91	18.78	13.56	9.58	10.48	.83	.27	.51	81.74	78.80	80.76	3.55	1.91	2.85	5.41	1:11.64
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.83	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	21	91.98	87.90	89.55	15.02	8.80	12.75	9.43	4.25	5.62	82.64	71.06	77.85	3.38	1.86	2.42	1.70	1:8.50
Corn kernels and cobs,	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.63	9.77	5.39	7.34	1.67	1:8.63
Wheat, grain,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18	1:6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	6.11	4.27	1:2.24

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V. Flour and Meal.																		
Corn meal,	17	89.29	82.96	87.14	16.08	10.07	11.30	5.74	3.10	4.46	83.24	73.20	79.87	3.92	1.56	2.73	1.65	1:3.79
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	9.33	78.07	68.00	72.27	4.78	3.69	4.08	2.71	1:3.82
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
VI. By-Products and Refuse.																		
Cotton-seed meal,	7	93.16	90.11	91.92	47.04	18.17	42.22	14.72	5.22	13.48	54.55	25.03	27.89	14.80	6.28	8.22	3.06	1:1.45
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	-
Wheat bran,	12	90.75	86.30	89.03	20.24	15.67	17.79	6.08	2.80	4.61	62.18	56.89	59.58	14.26	7.60	11.18	6.84	1:3.78
Wheat middlings,	3	90.75	89.45	90.45	19.21	17.23	18.21	6.46	3.19	4.63	74.30	61.62	69.52	8.40	1.40	4.11	3.45	1:4.10
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.40	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Gluten meal,	11	91.57	88.32	90.39	39.28	28.24	32.07	9.34	3.92	6.71	66.26	48.84	59.68	4.74	.27	1.16	.38	1:2.54
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewers' grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	-
Linseed cake,	1	-	-	91.65	-	-	37.25	-	-	5.69	-	-	40.85	-	-	8.69	7.52	1:1.62
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	1:2.07
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cocoa dust,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	71.57	16.58	13.15	14.86	1.46	-
Apple pomace (ensilage),	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar-beet pulp,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	1:7.10
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.79	33.77	31.36	32.98	1.21	1:30.85

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B. — *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
I. GREEN FODDERS.												
Fodder corn,	3	71.96	4.84	.52	.08	.24	.09	.03	.21	.64	.57	$3.76
Fodder corn (ensilaged),	1	71.60	–	.33	.05	.10	.09	.02	.14	.36	.04	1.68
Vetch and oats,	1	86.11	1.72	.79	.03	.09	.03	.01	.09	.23	.33	1.58
Cow-pea,	2	79.63	1.77	.45	.06	.44	.12	.01	.11	.42	.11	1.94
Serradella,	2	82.59	1.82	.42	.09	.46	.67	.02	.14	.41	.10	1.92
White lupine,	1	85.25	.74	1.73	.68	3.07	.73	.17	.35	.44	.90	3.39
Horse bean (whole plant),	1	74.71	–	1.37	.09	1.37	.62	.20	.33	.68	2.04	3.87
II. HAY AND DRY COARSE FODDER.												
Fodder corn,	5	–	4.91	.76	.10	.60	.69	.07	.51	1.80	1.65	7.38
Corn stover,	1	24.87	3.86	1.47	.79	.31	.09	.03	.20	1.00	1.32	4.89
Rowen,	1	8.84	9.57	2.86	.12	.85	.20	.06	.36	1.93	2.18	9.50
Herds-grass (timothy),	2	7.52	4.93	1.53	.22	.71	.10	–	.46	2.26	1.17	5.42
Red-top,	4	7.71	4.59	1.02	.44	.57	.13	.04	.36	1.15	1.74	5.21
Orchard grass,	4	8.84	6.42	1.88	.23	.46	.30	.03	.41	1.31	2.66	6.54

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Meadow fescue,	2	7.71	7.08	2.00	.11	.50	.14	.03	.23	1.05	1.68	5.55
White daisy,	1	9.65	6.37	1.25	.16	1.30	.20	.03	.44	.28	1.11	2.54
Lucerne (alfalfa),	2	8.37	6.82	1.46	1.08	2.02	.42	.10	.45	1.76	.70	7.76
Alsike clover,	2	8.47	11.11	2.17	.40	1.74	.67	.33	.80	2.36	3.23	10.82
Serradella,	1	10.54	10.60	.26	.55	2.63	.39	–	.90	2 54	.21	11.93
Vetch and oats,	1	11.42	10.96	.50	.20	.56	.19	.08	.60	1.50	2.12	6.25
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	4	86.08	1.13	.45	.08	.05	.04	–	.10	.24	.03	1.32
Beets, sugar,	2	84.65	.80	.22	.15	.12	.09	.02	.08	.25	.07	1.14
Mangolds,	2	87.29	1.22	.38	.13	.06	.04	.01	.09	.19	.03	1.08
Ruta-bagas,	2	87.82	1.10	.50	.10	.09	.03	–	.13	.21	.01	1.30
Turnips,	1	87.20	1.01	.41	.13	.12	.03	.01	.12	.22	.07	1.22
Carrots,	1	90.02	–	.07	.11	.54	.02	.01	.10	.14	.01	1.06
Apples,	2	79.91	.41	.19	.03	.03	.03	–	.01	.13	–	.61
IV. Grains and Other Seeds.												
Corn kernels,	8	10.88	–	.44	.04	.02	.21	.01	.73	1.93	.02	7.81
Corn and cob,	4	10.00	1.45	.44	.12	.66	.16	–	.60	1.46	.09	6.05
V. Flour and Meal.												
Wheat meal,	1	9.83	1.22	.17	.11	.54	.05	–	.57	2.21	–	8.65
Hominy feed,	1	8.93	1.89	.18	–	.49	.28	–	.98	1.63	–	6.14

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B. — *Analyses of Fodder Articles with Reference to Fertilizing Constituents* — Continued.

NAME.	Number of Analyses.	Moisture.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per ton of 2,000 lbs.
VI. By-Products and Refuse.												
Cotton-seed meal,	5	8.34	6.27	1.54	.17	.78	1.08	–	1.87	4.77	.58	$19.77
Cotton hulls,	3	10.13	2.61	1.08	–	.18	.26	–	.20	.75	.06	3.74
Wheat bran,	4	11.01	6.44	1.62	.18	.20	.90	.02	2.87	2.88	.13	14.61
Wheat middlings,	1	9.18	2.30	.63	.11	.20	.21	–	.95	2.63	–	10.63
Rye middlings,	1	12.54	3.52	.81	.03	.09	.32	.02	1.26	1.84	.17	8.46
Gluten meal,	3	8.75	.65	.05	.02	.03	–	.05	.40	5.21	–	18.23
Spent brewers' grain,	1	6.98	6.15	.30	.35	1.55	.29	.16	1.26	3.05	1.77	12.14
Linseed cake,	1	8.35	6.89	1.43	–	.64	.77	–	1.86	5.46	–	22.01
Pea meal,	1	8.85	–	.99	.62	.30	.30	.03	.82	3.08	.12	11.31
Broom-corn waste,	1	10.37	4.70	1.86	–	.24	.17	–	.46	.87	1.00	5.09
Cocoa dust,	1	7.10	6.35	2.11	–	.63	–	–	1.34	2.30	–	11.22
Apple pomace,	2	80.50	.27	.13	.03	.04	.03	.01	.02	.23	.01	.91

Note. — Basis of valuation, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide 4½ cents per pound.

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C. — *Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	* Soda Sol. required to neutralize 100 pts. Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12–15	3.09	–	–	–
" "	Oct. 9,	19.66	1.065	" "	6.25	–	–	–
" "	Nov. 27,	–	1.075	" "	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	" "	3.16	–	–	–
" " " . .	Oct. 9,	19.68	1.066	" "	7.14	–	–	–
" " " † . .	Nov. 27,	20.25	1.080	" "	11.36	–	–	–
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	" "	4.77	–	–	–
" "	Sept. 7,	16.55	1.060	" "	5.68	–	–	–
" "	Sept. 20,	–	1.065	" "	8.62	–	–	–
" " ‡.	Sept. 22,	–	1.060	" "	8.93	–	–	–
Cranberries, ...		10.71	1.025	15	1.35	–	–	–§
"	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), . .	–	–	1.045	25	–	1.92	6.09	45
" " " (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe),	–	–	1.050	18	–	2.19	7.02	85.6
" " (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
" " (not mellow),	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

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C.—*Analyses of Fruits*—Continued.

Wild and Cultivated Grapes.

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 pts. of Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	-
"	July 20,	1.0150	31	8.10	.625	7.72	216
"	Aug. 2,	1.0200	25	9.94	.938	9.44	249
"	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
"	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
"	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
"	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape,	July 19,	1.020	31	9.00	.714	7.93	204
" " "	Aug. 4,	1.020	28	12.25	1.100	8.98	249
" " "	Aug. 16,	1.025	28	12.48	2.000	16.03	233
" " "	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
" (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.060	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16 41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
"	Sept. 26,	1.075	24	19.34	15.43	79 78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
" " " (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	139
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	194

* One part of pure $Na_2 CO_3$ in 100 parts water.

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C. — *Analyses of Fruits* — Continued.

Effect of Girdling on Grapes.

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled, . .	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
" " girdled, . . .	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled, ...	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
" girdled, ...	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled, ...	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
" girdled, ...	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled, ...	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
" girdled, ...	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled, ...	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
" girdled, ...	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled, ...	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
" girdled, ...	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
" not girdled, ...	Sept. 26,	1.065	22	17.63	13.70	78.27	86
" girdled, ...	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
" not girdled, ...	Oct. 5,	1.075	12	20.92	17.50	85.37	42
" girdled, ...	Oct. 5,	1.085	12	–	17.86	–	54

* One part of Na_2CO_3 in 100 parts of water.

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C. — *Analyses of Fruits* — Continued.

Effect of Fertilization upon the Organic Constituents of Wild Grapes.

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per cent. of Grape Sugar.	Per cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	-	-	8.03	-	Unfertilized.
" " " " . .	"	19.55	-	-	13.51	-	Fertilized.
" " " Juice, . .	"	-	1.045	16	8.22	9.840	Unfertilized.
" " " " . .	"	-	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, . .	"	20.02	-	-	-	-	Unfertilized.
" " " " . .	"	21.65	-	-	-	-	Fertilized.
" " " Juice, . .	"	-	1.060	16	10.00	1.846	Unfertilized.
" " " " . .	"	-	-	-	14.29	.923	Fertilized.

Effect of Fertilization upon the Ash Constituents of Grapes.

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
" " "	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
" " .	July 17,	47.34	1.13	24.21	-	.75	21.38	.43	"
" " .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	"
" " .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.32	"
	1878.								
" " .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

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C. — *Analyses of Fruits* — Concluded.

Ash Analyses of Fruits and Garden Crops.

	Ash.	100 Parts of Ash contained—						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord grape (fruit),	-	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	-	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	-	40.69	-	6.85	6.24	-	9.04	-
Skins and pulp,	-	7.70	.42	57.36	3.80	.08	24.40	1.32
Seeds,	3.08	6.71	-	-	3.03	-	17.20	.29
Stems of grapes,	4.69	20.91	-	20.20	3.45	-	17.75	2.09
Young branches, *	-	24.71	.94	40.53	10.66	1.06	17.16	4.92
Wood of vine, †	2.97	22.57	-	9.72	4.28	-	14.07	23.84
Clinton grape (fruit),	-	58.45	3.51	13.34	7.37	.90	18.19	-
Baldwin apple,	-	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit), ‡	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
" " §	-	58.47	-	14.64	6.12	3.37	17.40	-
" vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	-	14.27	-
" vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	13.96	6.23	1.20	21.91	-
" white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	-
Crawford peach, sound,	-	74.46	-	2.64	6.29	.58	16.02	-
" " diseased, ‖	-	71.30	-	4.68	5.49	.46	18.07	-
Branch, sound,	-	26.01	-	54.52	7.58	.52	11.37	-
" diseased, ‖	-	15.67	-	64.23	10.28	1.45	8.37	-
Asparagus stems,	-	42.94	3.58	27.18	12.77	1.22	12.31	.06
" roots,	-	56.43	5.42	15.48	7.57	-	15.09	3.67
Onions,	-	38.51	1.90	8.20	3.65	.58	15.30	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

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D. — *Analyses of Sugar-producing Plants.*

Composition of Sugar Beets raised upon the college grounds during the season of 1870 and 1871.

NAME.	Date.	Brix Saccharometer (Degrees).	Per cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,*	" 19,	9	5.00	3.97

* Fodder beets.

Percentage of Sugar in Different Varieties of Sugar Beets grown on college farm during the season of 1882.

NAME.	Source of Seed.	Weight in Pounds.	Per cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. "	"	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	"	$\frac{3}{4}$ to $1\frac{3}{4}$	14.29
II. " "	"	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	"	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, ...	"	$1\frac{1}{2}$ to 2	13.10
II. " "	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

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D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Soil and Fertilization on Electoral Sugar Beets.*

Soil.	Manure.	Specific Gravity Brix (Degrees).	Per cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	" " " .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard manure and chemicals, . . .	12.75	9.17	3.58	71.92
" " .	Fresh hog manure, .	13.5	9.53	3.97	70.06
Light sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm.

Effect of Fertilization on Sugar Beets.*

Fertilizers.	Percentages of Sugar in Juice.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . .	12.55	13.24	10.50
Kainite and superphosphates, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam.

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D. — *Analyses of Sugar-producing Plants* — Continued.

Effect of Different Modes of Cultivation on Electoral Sugar Beets.

Locality of Beet-field.	Brix Saccharometer (Degrees).	Per cent. of Cane Sugar.	Non-saccharine Substances.
Sing Sing, N. Y., ...	11	7.80	3.20
Washington, N. Y., ...	14	10.97	3.03
South Hartford, N. Y., ...	15	11.70	3.30
Greenwich, N. Y., ...	12	9.50	2.50
Frankfort, N. Y., ...	13.5	11.00	2.50
Albion, N. Y.,*	18	15.10	2.90
" " †	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 12 lbs.

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D. — *Analyses of Sugar-producing Plants* — Continued.

Early Amber Cane.

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Sol. required to neutralize 100 pts. of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight,*	4.2	27	2.48	None	6.8	7.93
Aug. 16,	" " " " *	5.8	24	4.06	None	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	-	-
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	-	-
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	-	-
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	-	-
Sept. 21,	Juice from the above,*	13.0	21	-	-	-	-
Sept. 23,	" " " *	15.0	18	-	-	-	-
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	-	-
Sept. 28,	" " " †	17.3	12	16.60	-	-	-
Oct. 4,	" " " †	16.1	17	8.62	6.16	12.0	-
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	-
Oct. 8,	" " Stripped 2 weeks,†	12.8	17	5.16	5.27	7.0	-
Oct. 9,	" " " " †	18.4	17	7.57	-	10.6	-
Oct. 14,	Several weeks old,†	18.2	15	10.42	-	10.4	-
Oct. 18,	" " " †	15.1	23	7.57	-	-	-
Oct. 19,	" " " †	15.5	15	9.22	-	13.6	-
Oct. 22,	" " " †	16.2	16	8.30	-	-	-
Oct. 23,	" " " †	18.3	17	11.30	5.5	14.0	-
Oct. 24,	" " " †	16.6	15	8.63	-	9.0	-

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

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D. — *Analyses of Sugar-producing Plants* — Concluded.

Composition of the Juice of Corn Stalks and Melons.

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4.85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
" "	1.025	19	3.84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
" " ¶	1.050	20	2.27	5.38	–
" " **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

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Dairy Products.

NAME.	Volatile Matter and Moisture at 100° C.	Ash.	Fat.	Casein.	Non-nitrogenous Extract.
Whole milk, ...	87.40	.70	4.00	3.20	4.70
Skim milk, ...	89.81	.80	.37	3.53	5.49
Buttermilk, ...	91.84	.80	.21	2.79	4.36
Whole milk cheese (Jersey),* .	37.16	3.39	37.32	22.13	–
Whole milk cheese,* . . .	35.83	3.14	34 34	26.69	–
Cheese from milk skimmed after 12 hours' standing,* . .	37.30	4.52	27.81	30.37	–
Cheese from milk skimmed after 24 hours' standing,* . .	42.24	2.35	23.42	31.99	–
Cheese from milk skimmed after 36 hours' standing,* . .	43.95	5.14	17.67	33.24	–
Cheese from milk skimmed after 48 hours' standing,* . .	45.41	3.88	15.77	34.94	–
Cheese from skim milk with addition of buttermilk,* . .	48.38	4.64	18.35	28.63	–
Genuine oleomargarine cheese,*	37.90	4.50	31.66	25.94	–

* From analyses made in 1875.

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METEOROLOGY.

The meteorological observations of the past year have been a continuation of those of preceding years, being on the same general plan as recommended to voluntary observers of the United States Signal Service. Observations are made at 7 A.M., 2 P.M. and 9 P.M., and include observations of temperature, quantity and movements of the clouds, direction of the wind, the humidity of the air during the summer months, rain and snow fall, and of casual phenomena.

January opened with 4 inches of snow and good sleighing, which continued through the larger part of the month. On the 26th, a heavy snow-storm. At the close of the month the snow averaged about 18 inches. Quite a depth of snow remained on the ground until the thaw of the 20th of February. The snowfall for the month of February amounted to 9.5 inches. At the close of the month there were 6 inches on the ground.

From the 11th to the 16th of March occurred the severest storm of the season. This storm is recorded as giving 16 inches of snow, which amounted to 3.35 inches of water. The storm was accompanied by high winds. The comparatively warm weather which followed took the snow off rapidly. At the close of the month there were but 2 inches of snow on the ground. The last storm of the season occurred on April 10, with a record of 1.5 inches of snowfall.

The rainfall for the year amounted to 58.04 inches, or an average of 4.84 per month. According to the observations at Amherst, this is the heaviest since they were begun in 1836.

The average rainfall for the years 1836–1888 amounts to 44.34 inches. The smallest rainfall during this time was in

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1864, 34.44 inches; this was preceded, however, by a rainfall of 56.19 inches in 1863, which is, next to 1888, the highest for the period.

The largest rainfall during any one month was 10.70 inches in September. This record for one month has been exceeded only five times during the period covered by the Amherst observations (1836–1889). The rainfall was pretty evenly distributed throughout the rest of the year.

The mean annual temperature for the year is 43.98°. The average for the period from 1837–88 is 46.81. The average for the year 1875 was 44.22, which is the lowest except for the year 1888. The highest average thus far for any year has been 49.47°, in 1878. January, 1888, was the coldest month since 1837, being 9.5 lower than the average for that period. The temperature for October has been lower but once, — 1841, — and for April and July but twice, since the records began. The temperature for June, August and November was the average for those months, while December shows a considerably higher mean. February, March, May and September were considerably below the average. The weather during the growing months was quite favorable to the grass crop, but corn suffered considerably from the wet weather. The latter was unfavorable for the curing of both these crops.

The last killing frost of the season occurred May 8; the first in the autumn, September 7. The average date of the first killing frost in this vicinity is September 20. Light frost occurred May 16 and September 6. Snow-squalls occurred October 9; the first snow-storm happened November 25. This snowfall, amounting to 5 inches, was the only appreciable one during the month. The snow disappeared quickly. In December there were two slight storms, amounting to less than 3 inches.

The prevailing direction of the wind for the year was N. W. It was north-west in January, February, March, April, June, July, August, September, October and December; south-west in May, and north-east in November.

The number of days when the sky was less than four-tenths covered by clouds, clear days, was 58; the greatest number, 9, being in January, and the fewest, 1, in August.

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There were 97 "cloudy" days, or those when the sky was more than seven-tenths covered by clouds. March and October had 12 cloudy days each; April and July the fewest, 3 each. The remaining days were variable, being partly cloudy and partly fair.

The highest temperature of the year was 94.5°, occurring July 23; the lowest, —21.5°, occurring January 23. The maximum for the previous year, 1887, was 93.6°, on the 2d of July, and the minimum was —22.2°, on the 19th of January. The absolute range of temperature for 1888 was 116°, practically the same as for 1887, 1° less than for 1886.

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Summary of Meteorological Observations, 1888.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A.M.	2 P.M.	9 P.M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . .	11.0	18.6	12.9	13.78	28.9	—3.5	32.4	41.0	2d	—21.5	23d	-	-	-	-	3.87	1st
February, . .	16.1	28.7	22.1	22.05	36 9	.3	36.6	49.0	14th	—19.0	10th	-	-	-	-	3.94	20th
March, . . .	22.2	32.5	26.3	26.82	41.9	18.8	23.1	49.0	21st	—3.0	19th	-	-	-	-	5.96	11th to 14th
April, . . .	35.8	49.2	39.5	40.44	67.3	28.3	39.0	84.0	29th	15.0	9th	-	-	-	-	3.08	5th
May, . . .	49.6	62.7	53.2	54.70	68.0	39.7	28.3	80.0	29th	26.0	3d	82.7	61 3	79.3	74.4	4.29	11th
June, . . .	61.5	74.1	63.6	65.82	79.2	56.4	22.8	94.5	23d	38.0	2d	81.4	60.4	77.7	73.1	5.40	23d
July, . . .	61.6	76.5	65.5	67.20	73.4	60.2	13.2	85.5	5th	46.0	14th, 18th	82.9	53.1	78.6	71.5	3.63	19th to 20th
August, . . .	63.1	75.4	65.5	67.38	78.6	57.0	21.6	87.0	16th	42.0	23d	85.5	61.5	83.0	76.7	4.29	12th to 13th
September, . .	52.6	65.1	56.0	57.10	70.9	36.9	34.0	76.0	2d, 17th	25.0	30th	93.3	63.0	86.5	80.9	10.70	20th to 21st
October, . .	38.7	49.2	42.1	43.12	53.0	35.1	20.9	66.0	5th	26.0	11th	89.0	65.2	82.1	78.1	5.19	6th to 7th
November, . .	35.2	47.9	38.0	38.93	59.6	13.9	45.7	71.0	2d	5.7	23d	-	-	-	-	3.91	8th to 10th
December, . .	26.4	35 4	29.9	30.40	49.4	9.4	40.0	56.5	25th	3.5	14th	-	-	-	-	3.78	16th to 18th
Sums, . .	473.8	615.3	514.6	527.74	710.1	352.5	357.6	839.5	-	188.7	-	514.8	364.5	487.2	454.7	58.04	-
Means, . .	39.5	51.3	42.9	43.98	59.2	29.4	29.8	70.0	-	15.7	-	85.8	60.8	81.2	72.5	4.84	-

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Miscellaneous Phenomena — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.
January, ...	–	4, 8, 10, 13, 17, 25, 26,	1, 15,	–	–
February, ...	–	4, 7, 10, 11, 18, 25,	4, 8, 20, 25,	–	24
March, ...	–	2, 11, 12, 13, 21, 26,	20, 21, 22, 26, 27, 28,	–	25
April, ...	4, 17, 23, 24, 25,	10,	1, 2, 5, 10, 12, 14, 18, 20,	5,	–
May, ...	3, 8, 16,	–	1, 5, 8, 10, 11, 12, 13, 14, 15, 16, 18, 28, 29,	14,	21
June, ...	–	–	6, 7, 14, 15, 20, 21, 23, 24, 26, 28, 30,	6, 14, 15, 21, 23, 24, 30	–
July, ...	–	–	1, 5, 9, 11, 19, 20, 27, 31,	1, 5, 11,	–
August, ...	–	–	4, 5, 6, 12, 13, 17, 21, 22,	4, 17,	18
September, ...	6, 7, 29, 30,	–	1, 8, 12, 16, 17, 18, 20, 21, 26,	20, 21,	15
October, ...	1, 3, 4, 11, 15, 19, 22, 26, 30,	–	1, 2, 6, 7, 12, 13, 14, 16, 17, 19, 24, 27, 28,	–	–
November, ...	13, 17, 21, 22, 23, 24,	25,	3, 8, 9, 10, 15, 16, 19, 26, 27, 29,	–	14
December, ...	3, 7, 21, 22,	4, 9,	6, 11, 16, 17, 18, 27,	–	15

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RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter beginning with the year 1836.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23.026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24.510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25.276	1867, . . .	67.920

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Record of Temperature, etc.—Concluded.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30.506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24 220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886-87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893

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JAMES P. LYNDE, *Treasurer, in Account with the* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1888.		RECEIVED.		1888.		EXPENDED.	
Jan.	1,	Cash balance in bank,	$263.11			Salaries,	$3,873.76
	4,	State Treasurer,	2,500.00			Laboratory supplies,	747.61
	11,	Dr. C. A. Goessmann, Director,	222.46			Printing and postage,	641.00
	11,	Dr. C. A. Goessmann, Director,	176.27			Office expenses,	287.33
April	2,	State Treasurer,	2,500.00			Farmer and farm labor,	1,813.73
June	19,	Dr. C. A. Goessmann, Director,	99.62			Farm supplies,	533.34
July	5,	State Treasurer,	2,500.00			Stock,	95.00
Sept.	28,	State Treasurer,	2,500.00			Feed,	281.55
Oct.	13,	Dr. C. A. Goessmann, Director,	162.00			Miscellaneous expenses,	491.83
Nov.	6,	Dr. C. A. Goessmann, Director,	200.00			Construction and repairs,	2,935.84
Dec.	3,	Dr. C. A. Goessmann, Director,	10.00			Expenses Board of Control,	137.80
	22,	Transferred from Hatch Funds,	705.33				
			$11,838.79				$11,838.79

Examined, compared with the vouchers, found correct, and approved. WM. R. SESSIONS, *Auditor*.

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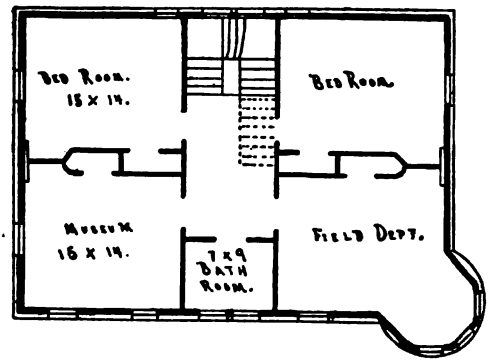
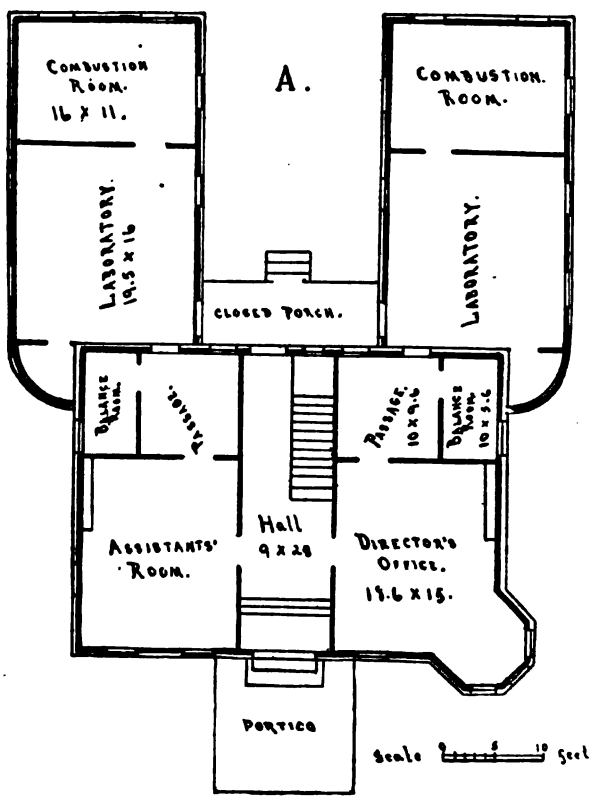
B.



STATION BUILDING – 2nd FLOOR.



STATION BUILDING – GROUND PLAN.

A. Laboratory Building..... Ground Plan

B " " Second Floor

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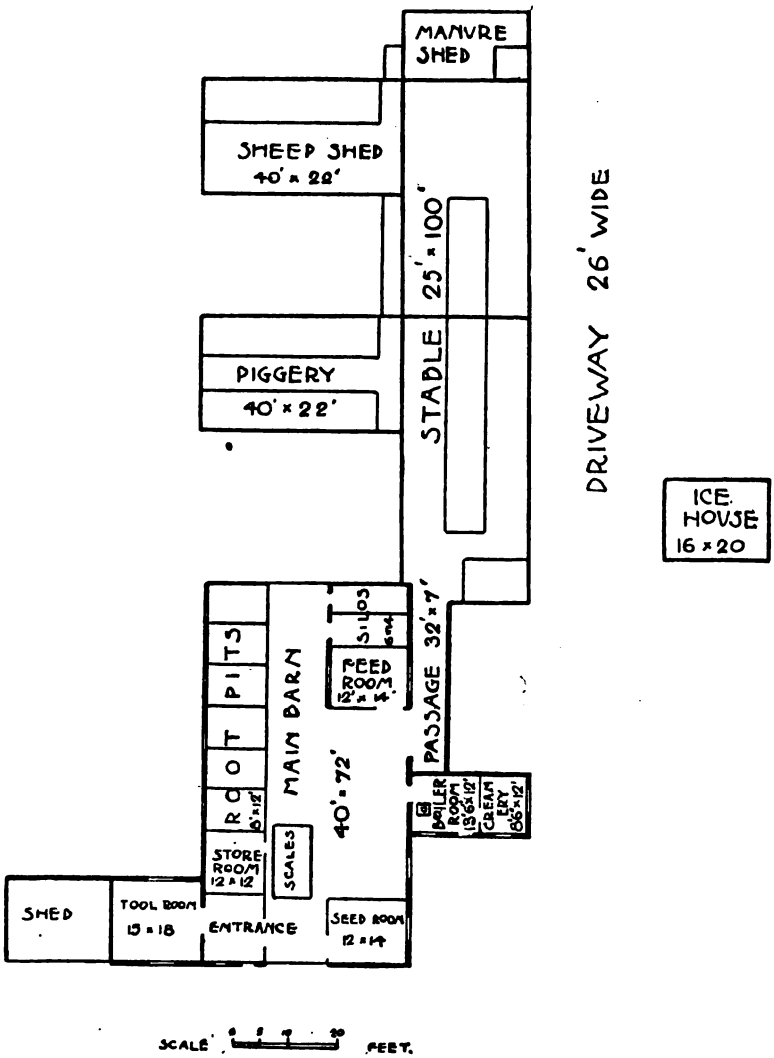

PLAN OF FARM BUILDINGS.

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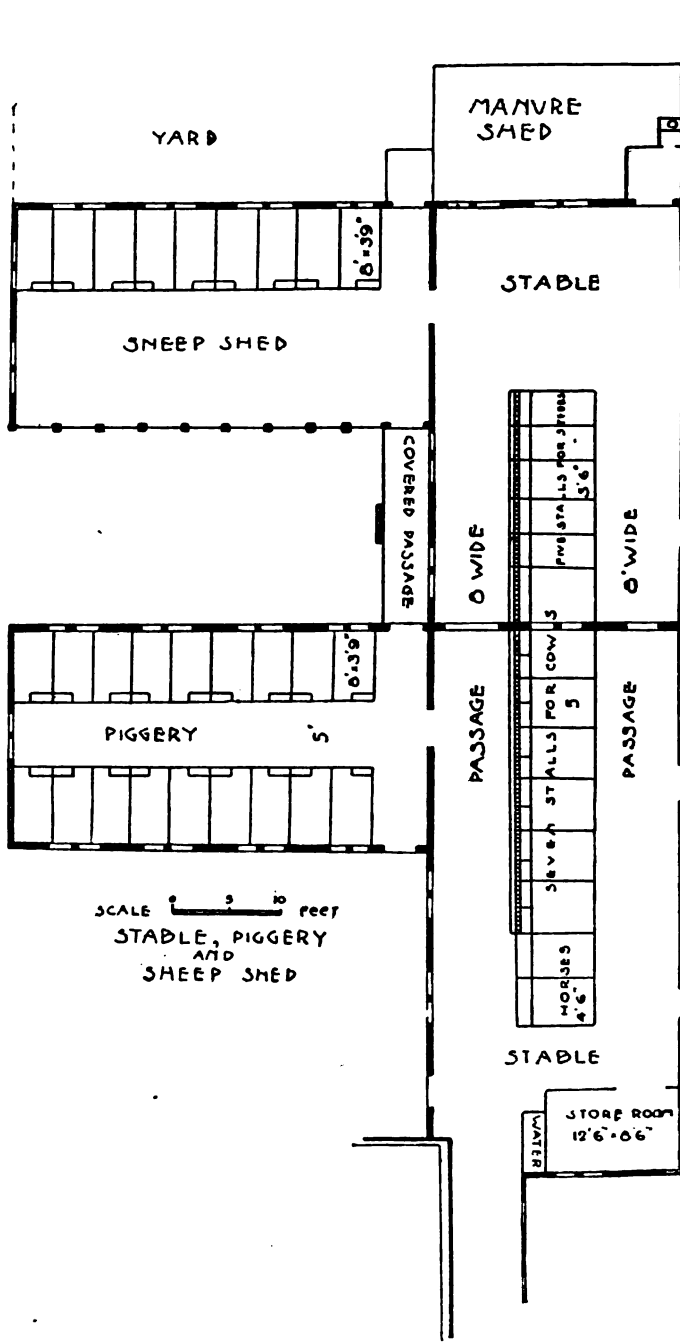

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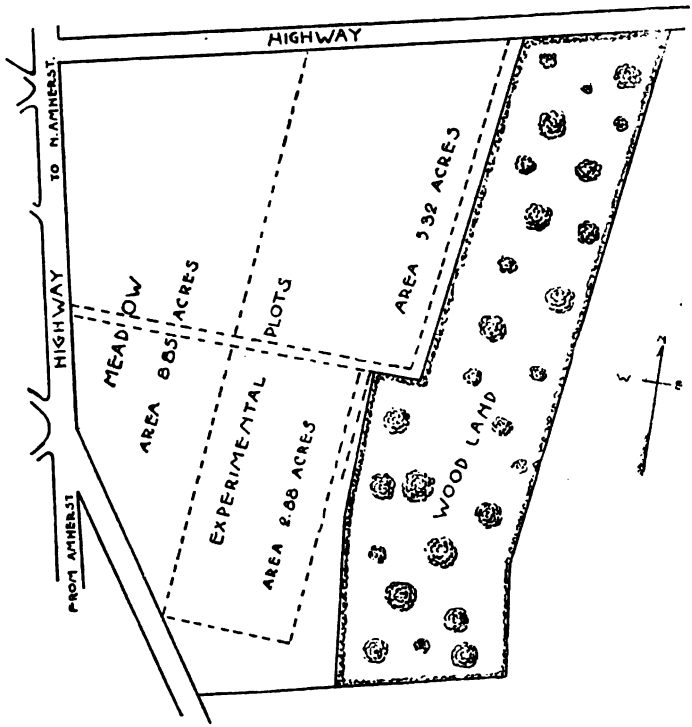

MAP OF LAND LEASED TO THE
MASSACHUSETTS EXPERIMENT STATION
FROM THE
AGRICULTURAL COLLEGE FARM
EAST OF THE HIGHWAY
AREA TAKEN 30.52 ACRES

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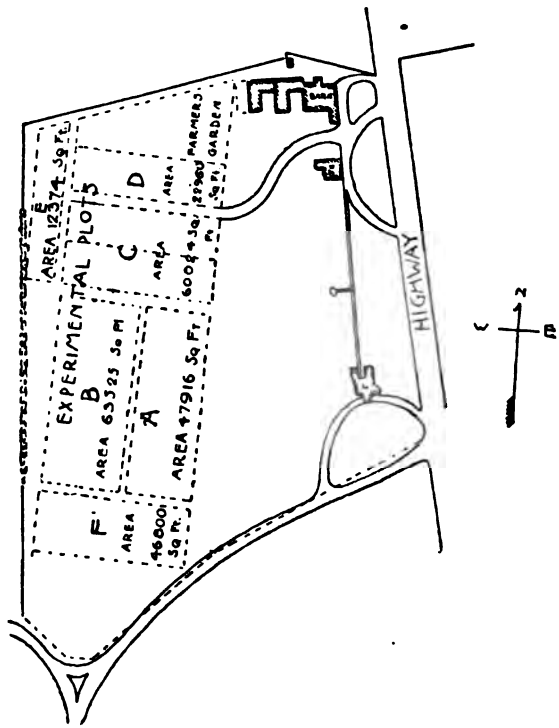

MAP OF LAND LEASED TO THE
MASSACHUSETTS EXPERIMENT STATION
FROM THE
AGRICULTURAL COLLEGE FARM
WEST OF THE HIGHWAY
AREA TAKEN 17.72 ACRES

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